

SCIENCE.

FRIDAY, NOVEMBER 30, 1883.

JOACHIM BARRANDE.

I., HIS LIFE.¹

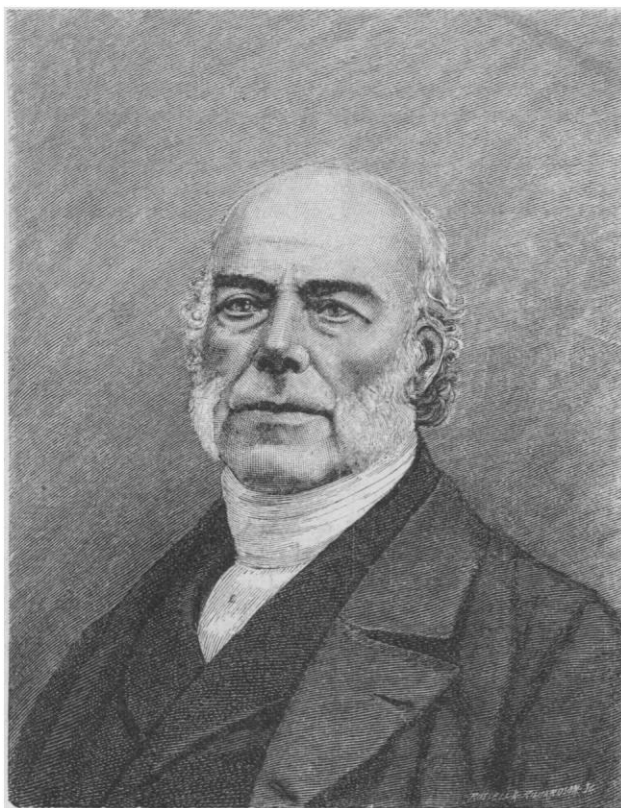
THE death of Joachim Barrande, who for more than half a century has attracted the respectful regards of the world of science, severs the last link between the times of Cuvier and our own. The example of this noble life may be truly said to have borne threefold fruit. He was, after Cuvier, intellectually by far the most dangerous of the opponents of evolution. He was great in his works, and great in the example of a life devoted to research and to the service of his unfortunate sovereign. He belonged to that illustrious body of men who acknowledged Cuvier as their teacher of science; and, in order to understand him, one must recognize this, and also realize that to him loyalty was inseparable from faith and truth. The chivalrous side of

his character is best illustrated by the reason which he gave for refusing peremptorily the high honor of an election to the French academy. He said simply that he had no desire for membership in a society with such avowed aims, but which had refused admission to some of his masters in science, — Alcide D'Orbigny,

Deshayes, and Edouard Lartet, who had taught him all that he knew. He dedicated himself to science always without personal reservation; but his opinions were never free. He was bound by his loyalty to the memory of his masters in science, and by his faith in the doctrine of the divine right of kings; and both in science and in politics he remained throughout life a consistent opponent of the new theories of evolution and republicanism.

Born in the year 1799, in the town of Saugues, department of Haute Loire, we

first hear of him in 1819, when he entered the École polytechnique of Paris, whence he graduated in 1821 among the first in his class, and then passed into the École des ponts et chaussées, graduating in 1824 with high honors.



J. Barrande

¹ We are indebted to Professor Jules Marcou, an intimate friend of M. Barrande, for the personal facts in this notice.

During these five years he was assiduous in his attendance on the various courses of lectures given by Cuvier, Brongniart, De Jussieu, Constant Prévost, and Desfontaines, upon zoölogy, geology, and botany, and constantly visited the collections of the Jardin des plantes. After graduation he was appointed engineer at a small town in the basin of the Loire; and there, during one of the visits of Duc D'Angoulême, then the dauphin of France, he was presented to the duke; and any one who has ever had the privilege of Barrande's acquaintance will readily understand the favorable impression his character and attainments made upon his royal highness. Subsequently the young engineer became the most favored candidate of the dauphin for the office of instructor in science to his nephew, the Comte de Chambord, the grandson of Charles X.; and he secured this post for him. The unsolicited appointment to what was considered and sought by learned men as one of the highest honors in the gift of the king, reads like the climax of a fairy-tale; and like that, also, the daring of the young engineer in accepting the appointment had the happiest results for himself and for his royal charge.

The revolution of 1830 put an end to the reign of Charles X., and drove the elder branch of the Bourbon family and their faithful servitor into exile; and it was during the sojourn in England and in Scotland that Barrande perfected himself in the use of the English language. In 1832 they removed to Prague, and carried with them this man who was to make Bohemia classic ground for the geologists of all countries. Barrande found himself here in a new field, where all his previous education and preparation were at fault; but for a true investigator, such as he was, this merely excited the greater interest. He and his pupil began by collecting every thing in the vicinity; and then, little by little, their attention was irresistibly drawn to the fascinatingly rich deposits of Silurian fossils.

Their collections in time became too extensive to be accommodated in the halls devoted to study at the Chateau de Hradschin, and

Barrande removed his collections to a house which he had purchased as a residence for himself. With immense labor, and without assistance from books, he built up the first steps of a classification by which he could arrange his collections in natural sequence and in their respective faunas. In 1840 he met with a copy of the 'Silurian system' of Murchison, and became assured of the fact that he was working among similar fossils and in the same geological period. This service was later gratefully and intentionally recognized in the general title of his works, 'Système silurien du centre de la Bohême.'

The royal family changed their residence, going first to Goritz, and then to Frohsdorf; but Barrande, though continuing to serve the Comte de Chambord, having exchanged the post of tutor for that of trusted friend and superintendent of finances, did not live in his household, being permitted to remain with his beloved collections at Prague. His duties, however, called him a part of the year to Paris; and he there leased apartments, first in the rue Mézières, and subsequently in the rue de l'Odéon. There are probably few geologists of reputation who have not, in passing through Paris, made these apartments a visit, and experienced the delight of being received by this stately and warm-hearted gentleman.

Besides the mastery of English, Barrande found it necessary to acquire German, which he spoke and wrote with facility, and also the Czech language, in order to direct and control the workmen employed by him as collectors of fossils. These men varied in number at different times, from six to twenty, and sometimes even to thirty. The practical difficulties which were overcome in this part of the work, and the anecdotes which might be related of the efforts made to deceive him about the localities of fossils, for which he had offered special rewards, would be instructive as well as amusing. We have, however, space only to relate that he acquired among his workmen the reputation of being a generous gentleman, but one of great firmness; and, being obliged also to account for powers beyond their com-

prehension, they attributed to him a mastery of the black art of divination, and a possible intimacy with the devil himself.

In finishing his work, neither money nor labor was spared: the best illustrators were constantly employed; and one, M. Humbert, became noted, lived constantly with him, and died in his employ after twenty-five years of service.

Barrande found it necessary to be his own publisher. He accordingly organized a French press at Prague; and the typography of his books justify his own assertion, that they could not have been printed with greater technical elegance by any press in Paris. We know from personal inspection that errors are very rare. The quotations, which generally show carelessness, if any part of a book does, excel in this respect; and the desire for correctness has been carried so far, that, instead of tables of 'corrigenda,' he has carefully corrected errors with printed slips pasted upon the pages of the text. All this was done while engaged in administering a fortune of about fifty millions of francs, and arranging many complicated questions of business connected with his position, and relations to the Comte de Chambord, which required much time, and many journeys to different parts of Europe. That this was accomplished successfully is shown by the terms of the will of this last heir of the elder Bourbons, who appointed him his executor. The expenses of the whole work were met by the personal sacrifice of his own income from all sources, but principally by the generous assistance of his royal friend. These presents were always made with the greatest delicacy by the count as his subscriptions to the '*Système silurien de la Bohême*;' and Barrande has recognized their essential importance in dedicating each of his volumes to this generous patron, and also by a direct statement that his own labors would have failed but for this assistance. The world of science owes to the Bourbon family its perpetual recognition of this example of friendship and generosity, which has brought out to full fruition the life of one of its representative men.

No government can point to a finer single monument to science than this one, created by an exile in a foreign country; and the sums expended were large, since, as we are assured, the average cost of each of the twenty-two volumes, as estimated by Barrande himself, was not less than twenty thousand francs, making a grand total of nearly ninety thousand dollars for the parts published up to the present time. M. Barrande never married; and his only surviving relatives are a sister, Mme. Vuillet, and a brother somewhat younger, M. Joseph Barrande, a distinguished engineer.

It is impossible adequately to present a life so varied and so full of activity in every direction, at once scientific, and yet so picturesque from political and social stand-points. He had become, before his death, the only survivor of the ancient servitors of the royal house of France; and the cause, and even the surroundings, of his death, completed the beautiful picture of his life of voluntary exile and chivalrous service. He sacrificed himself to his duty as executor, and died from a cold contracted from exposure while engaged in carrying out the last wishes of the man who had been to him pupil, friend, patron, and rightful sovereign. His decease took place Oct. 5, at the Chateau of Frohsdorf, near Vienna, under the same roof, and within a short time after the death of the Comte de Chambord. We who are republicans cannot estimate his motives, nor feel with him as a royalist, but we can respect the rare moral qualities of his devotion; and we feel, also, that it is essential to express our reverence and gratitude to the memory of a really great man for his consideration and kindness to all young students in science who have had occasion to come into personal or professional relations with him.

WHIRLWINDS, CYCLONES, AND TORNADOES.¹—IV.

THE beginning of the upsetting in a tropical cyclone is not fully accounted for by observation. It is not so easily explained as the first

¹ Continued from No. 42.

uprising on the desert, inasmuch as the ocean's calm surface is too smooth to offer any distinct starting-point for the up-draught. There are, however, several plausible ways out of the difficulty. It is possible that localized warmth and expansion where the air is calmest may produce a gentle up-current, which, once begun, will be soon well established. Again: an excess of evaporation will cause a rapid upward diffusion of vapor. It will reach an altitude where it must condense, and form a cloud-layer, and thereby warm the surrounding air both by its latent heat and by catching the warmth of the sun's rays; and, as this will go on at a considerable altitude, it will be especially effective. Finally, if after a time of calm a breeze should opportunely penetrate the district from an adjoining one of higher pressure, an ascending current would surely be started. In some such way a gradual overturning of the unbalanced air must begin, and its further action is now to be traced.

The rising mass expands as it escapes from the pressure of the air that it leaves below, and in expanding it is mechanically cooled. As it cools, some of the vapor with which it is well charged condenses into cloud, and, on accumulating, soon begins to fall as rain. Here we have the entrance of a new and potent cause of disturbance, — the bringing-forth of a great amount of energy in the form of heat from the condensation of the vapor. It is probable that this aid to the up-draught seldom takes the initiative: it waits till some other cause begins the upsetting, and then falls to with a will to help it along.

This effect of condensation is so important that it may well be considered a little more closely. As water evaporates, its molecules are spread widely apart, and take on a very active motion; but in doing so they must be furnished with energy in some form, for they cannot develop out of nothing the energy needed for their increased activity. As a general rule, the desired supply is found in the sun's radiant heat: so, when water evaporates from the sea-surface, it takes to itself nearly all the energy that comes down in the sun's rays, and thereby its molecules are enlivened up to the point of vaporization. It will be readily understood, that, if heat-energy be taken by the water and transformed into vapor-energy, it can no longer make itself felt as heat; and, so far as our senses are concerned, it is lost or hidden, and for this reason is called 'latent heat.' The term is misleading and improper, for it implies that the sun's energy still remains somewhere in the vapor as a kind of heat that

we cannot feel; but this is wrong, for as heat it no longer exists. It will be further seen, that, when the vapor is condensed back again into water, all its vapor energy must take some other form: it must abandon the vapor molecules, and allow them to quiet down and approach one another as they resume the liquid condition; and the energy thus thrown out of employment must make itself felt in some other way. We are therefore prepared to find that condensation is attended with the production of just as much heat-energy as was lost in the process of evaporation. This is of capital importance in the understanding of storms.

It has already been seen, that the cause of continued action in a desert-whirl is found in the excessive warmth of the lower strata; in virtue of which the air in the ascending column finds itself warmer, and hence lighter, than the surrounding air, and consequently is impelled to rise as oil rises through water. It was further noted, that the ascending whirl will continue as long as it is supplied with excessively warm air at the base; but, as soon as the bottom air is not more than 1.6° warmer than the air three hundred feet above it, the whirl will die away. In the case of an ascending column of air saturated with vapor, it would also, as in the previous case, expand as it rose to higher levels of less pressure, and, in consequence of this expansion, it would cool. But when saturated air is cooled, some of its vapor must condense; and when vapor condenses, heat is evolved; and the heat thus produced will partly make up for the loss of heat by expansion, and therefore the ascending column of moist air will not be allowed to cool so fast as if it had not been saturated with vapor. Several important consequences now follow. In the first place, a less warming at the base is needed to produce unstable equilibrium in saturated than in dry air. In the latter, the turning-point is

reached when there is a difference of 1.6° F. between the temperatures of the surface-air and that three hundred feet above. In the former, if the surface-temperature be 80° , as is common in the Bay of Bengal, a difference of only 0.6° is required. In other words, if a mass of dry air at 80° rise three hundred feet, its temperature falls to 79.4° ; if a mass of saturated air at the same temperature (fig. 5) rise through the same distance, it is cooled only to 79° ; and conse-

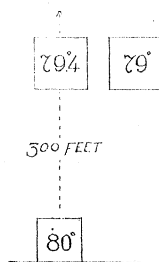


FIG. 5.

quently, for every three hundred feet of ascent it has an advantage over dry air of one degree of warmth (and more at great altitudes), tending to make it lighter than its surroundings, and so intensifying its upward motion. Moreover, a storm which is thus nourished may continue its activity through the night, instead of dying away as the sun declines; for it is supplied with energy continually brought out of the vapor storehouse. Of course, in both cases the sun's heat is the source of the disturbance; but on the desert there is no way of storing up the heat, while at sea a great amount of energy may be stored up before the final upsetting begins, and then the storm-winds arise, and show all this accumulated strength in their blowing.

We have much this kind of action, in a small way, in the formation of a heavy cumulus-cloud on a quiet, hot summer day. The air on the ground is warmed, and contains a good share of moisture; and, as it rises and cools, its vapor begins to be condensed. Some of the vapor-energy is given out as heat, and so the ascending current is re-enforced. If the air be very warm or very moist, or both, the ordinary cumulus-cloud may grow into a thunder-shower; and, being then unable to carry up all its condensed vapor, some of it falls as rain. It should be noted, that, when the lower air is not fully saturated, its temperature must be somewhat reduced to bring it to the point of saturation before any cloud is formed. This decrease is mechanically effected at the rate of 1.6° every three hundred feet, by the expansion of the rising air, — essentially the same rate as that already given for the cooling of a rising column of dry air; and, when enough cooling has been thus effected to reduce the air to its temperature of saturation, some of the vapor will be condensed into liquid cloud-particles, and so become visible. It is for this reason that cumulus-clouds have nearly level bases, and that a group of such clouds stands at about the same altitude. The air-currents rising from the warm ground have to ascend a certain distance, and cool a certain number of degrees, before condensation takes place. Their altitude in feet will be about a hundred and eighty-three times the number of degrees between the temperature of the lower air and its dew-point.

All tropical cyclones are attended by clouds and by excessively heavy rain; and this points very clearly to the important part played by

the heat evolved in the condensation of so much vapor. The rapid reproduction of the heat stored up through many previous days of sunshine retards the cooling of the ascending current, excites the winds to active motion, and the storm is thus set going. Espy (1835) was the first to recognize the important part played by the condensing vapor in an ascending current of air, but he greatly exaggerated its effects. The proper measure of its action, and convenient statement of the results in tabular form, are chiefly due to Reye (1864) and Hann (1874).

The ascending current moves outward at a

10,000'	20"
ALTITUDE	BAROMETER
	22
5,000'	24
	26
	28
0	30"
	SURFACE OF THE SEA

FIG. 6.

height of one or two miles, spreading itself over the surrounding atmosphere. To show its relation to the storm circulation, we may refer to the following figures. Fig. 6 shows the air in a quiescent state, before the storm begins. At such a time, there being no wind, the weight of the air, or the barometric pressure at sea-level, — say, 30 inches, — is uniform throughout the area preparing for cyclonic disturbance. The pressure is uniform, not only at the sea-surface, but also at any given altitude above it (the effect of the upper winds is here omitted as being non-essential to the explanation, as well as unknown); so that the lines in the figure will represent level surfaces of equal pressure of 28, 26, 24 inches, or isobaric planes at altitudes of about 1,600, 3,300, and 5,000 feet. As long as the vertical gravitative pressure is at right angles to these planes, the air is not tempted to move, but will remain at rest till disturbed by some new condition. This new condition will be some form of the disturbing actions already suggested, by which a central region of greatest warmth is determined, in consequence of which there will be an expansion of the atmosphere at that place. The isobaric planes will become convex there, as in fig. 7; for the altitudes at which barometric pressures of 28, 26, 24 inches are found may now be greater than before. As there been, as yet, no lateral motion, this produces no change in the pressure at sea-level.

reason for lateral motion has now appeared: the gravitative pressure of the upper air is no longer at right angles to the convex isobaric surfaces, and consequently there will be a tendency for the air to slide down from the centre. In obedience to this impulse, some of the central expanded air moves laterally or radially outward to the marginal region; and now there

margin. Now, in virtue of the greater distance between the isobars at the centre, the altitude of some surface, say that of 24 inches, will be as great there as over the marginal region, in spite of the inequalities of pressure and inward slope of the isobars at sea-level; and at greater altitudes the isobaric surfaces will become convex, and hence slope outwards,

instead of inwards, as below. The two directions of slope will be separated by a level or neutral plane, on which there will be no tendency to motion. Here we have excellent illustration of the convectional motion of the wind in a storm. It ascends at the centre, where it

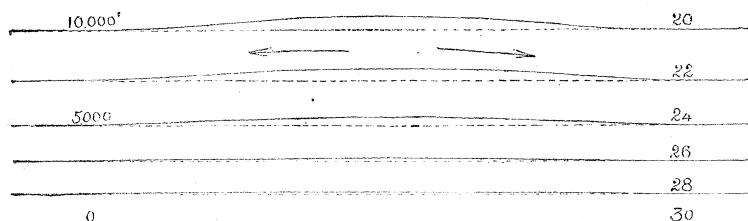


FIG. 7.

is no longer a uniform pressure of 30 inches at sea-level. At the centre, whence the upper air has rolled away, the pressure will be reduced, let us say, to 29 inches: on the surrounding district, over which the air has advanced, the pressure has increased to 30.25 inches. In this new arrangement of pressures there is cause for still further gravitative motion; namely, a rising of the air at the centre, a sinking at the marginal region, and a horizontal motion along the sea-surface, toward the centre of low pressure, in the attempt to restore an equilibrium. But this will not fully overcome the inequality of pressures, or correct the sloping of the isobars; for the existence of an ascending and expanding warm current at the centre requires that the isobaric surfaces there shall be separated by a greater vertical distance than in the normal cooler air of fig. 6. Further, the marginal descending current of air, greatly cooled by radiation in the upper regions, is heavier, volume for volume, than the ascending current, and hence has its isobaric

surfaces closer together than usual. A shorter vertical column of it is needed to balance an inch of mercury in the barometer. Fig. 8 shows a final condition,—the diminished pressure at the warm centre; the increased pressure and greater separation of the isobaric lines at the marginal region; the increased pressure and closer approach of the isobaric lines in the cooler

is lightest; it then flows outward, down the barometric gradient; it sinks at the marginal region of higher pressure, and then flows inward, down the reversed gradient, back to the centre again. This may be called the vertical circulation of the storm; and it will be continued as long as the central current is warmed to excess, so as to raise its isobaric surfaces. In the desert-whirlwind we have seen that the supply of warm air depends immediately upon contact with the surface-sands heated by direct sunshine. In the cyclone at sea, the greatest part of the warmth needed is given out by the vapor that condenses at the centre, and falls in the heavy rains, without which a cyclone cannot form. Such a storm may last many days.

The explanations thus far given of the be-

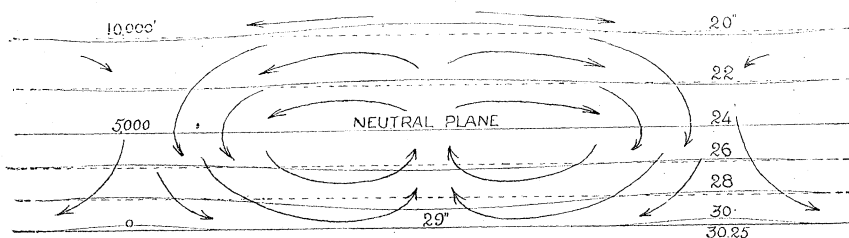


FIG. 8.

ginning of a cyclone apply strictly only to the hurricanes of tropical latitudes; for in the temperate zones our numerous storms are by no means always dependent on local warmth and calmness of the air. The most that can now be safely said of the origin of such storms is, that they depend on some immediately preceding

disturbance, somewhat as one water-wave depends on another; for no one has yet been able to trace one of our storms so far back as to show it quite independent of previous storms, as seems to be the case with the tropical cyclones. In the irregular blowing of the winds of higher latitudes, for which no full explanation can be given, too much air is accumulated in certain districts, which then appear as regions of high pressure. In seeking a better balanced re-arrangement, surface-currents are established with a rotary deflection, as explained below, toward intermediate areas of lower pressure; and an up-draught is formed at their meeting. This becomes a storm-centre. It might be said that friction would soon cause all these local disturbances to cease, and atmospheric pressure would then remain more uniform. So it might, if the air were dry; but the condensation of vapor, by which the cooling of the ascending current is retarded, brings out a new supply of energy every time an up-current is established; and thus the disturbed condition of the atmosphere is maintained. It cannot settle down into a condition of equilibrium as long as the sun shines, and water evaporates. Some maintain that it is unlikely that the storms of the torrid and temperate zones should have different causes, and that as temperate storms certainly do not, as a rule, arise in a warm calm, tropical storms cannot have such an origin. But as already stated, and as will be further shown, the regions and seasons of tropical cyclones point very conclusively to this origin; and, moreover, it is not necessary that similar results should have identical causes. All the peculiarities of a rotary storm can be satisfactorily explained from either starting-point. And the essential contrast between the two cases is, that in one, differences of temperature precede and bring about differences of pressure, and, in the other, differences of pressure precede and bring about differences of temperature; so that, in both cases, the established storm differs in temperature and pressure from the surrounding atmosphere: and, once established, the motions of rotation and translation, yet to be described, are closely alike in the two cases.

(To be continued.)

THE ELECTRIC LIGHT ON THE U. S. FISH-COMMISSION STEAMER ALBATROSS.¹—III.

To determine the efficiency of the system of incandescent lamps, I measured, by means of

¹ Concluded from No. 42.

a steam-engine indicator, the power required to run the engine and dynamo, the current being switched off. By the same instrument I measured the indicated power required to run 45, 50, and 70 lamps, respectively. By deducting from these experiments, respectively, the power required to run the engine and dynamo, we obtained the power applied to the shaft; and from this quantity we deducted the friction of the load, leaving, as a remainder, the net powers required to revolve the armature in the magnetic field with 45, 50, and 70 lamps in circuit. The lamps used were each of eight-candle power.

Efficiency of the incandescent lamps.

Horse-power required to run the engine and dynamo	5.36
Indicated horse-power required to run 45 incandescent lamps	5.79
Indicated horse-power required to run 50 incandescent lamps	5.85
Indicated horse-power required to run 70 incandescent lamps	6.92
Net horse-power applied to the revolution of the armature in the magnetic field, using 45 incandescent lamps	1.80
Net horse-power applied to the revolution of the armature in the magnetic field, using 50 incandescent lamps	1.85
Net horse-power applied to the revolution of the armature in the magnetic field, using 70 incandescent lamps	2.84
Mean number of incandescent lamps per indicated H.P., using 45 lamps	7.77
Mean number of incandescent lamps per indicated H.P., using 50 lamps	8.50
Mean number of incandescent lamps per indicated H.P., using 70 lamps	10.11
Mean number of incandescent lamps per net H.P., using 45 lamps	25.
Mean number of incandescent lamps per net H.P., using 50 lamps	27.02
Mean number of incandescent lamps per net H.P., using 70 lamps	24.63

The wires being fixed, their resistance may be considered a constant quantity, and the only variation as existing in the engine and dynamo. The distribution of the power, as above recorded, may, if necessary, be verified by electrical measurements on the wires.

To illuminate the machinery on deck, the derrick-gaff, the lead of the cable, the trawl as it comes on deck, and to afford ample light to the naturalists while culling the contents of the trawl as delivered on deck, an arc-light of great power became indispensable. In the then existing state of electric lighting, an additional dynamo appeared to be imperative, as no arc-light had been run from a tension of 51 volts.

The Edison company, however, was willing to experiment, and in a short time produced a

lamp of 750-candle power, which we are now using; and we find, in practice, that a no. 18 copper wire will carry the current without heating. The power of this lamp, to be comparable with other arc-lamps, should be multiplied by four, as the commercial candle-power of the arc-lamp is the aggregate of four measurements, the photometers being placed equidistant from each other in the same circumference. The power required to drive these arc-lamps, though more than necessary for others of equal power, is yet quite small.

Efficiency of the arc-lamps.

Indicated horse-power developed by the engine with two arc-lamps in circuit	6.69
Horse-power required to drive the engine and dynamo	3.56
Net horse-power applied to the shaft	3.13
Horse-power absorbed in the friction of the load	0.23
Net horse-power applied to the revolution of the armature in the magnetic field	2.90
Net horse-power applied to the armature for one lamp (half of the last quantity).	1.45

The number of eight-candle power incandescent lamps per indicated horse-power is taken as a mean between the quantities as determined above, i.e., —

$$\left(\frac{25 + 27.02 + 24.63}{3} = \right) 25.55;$$

and this quantity multiplied into the net horse-power required to drive one arc-lamp gives ($25.55 \times 1.45 =$) 37.04, which is the power in units, of incandescent lamps, to run one arc-lamp of 750-candle power.

Fishermen in nearly all parts of the world use a light in their boats, when fishing at night, to attract fishes into their nets; and it is a common thing for flying-fish to come on board ship at night if a light be advantageously placed to attract them.

Until incandescent lamps were invented, there were no convenient means of sustaining a light beneath the surface of the waters; and there is consequently opened up to us an unexplored field in fishing.

Just what service our submarine lamps will be, we are as yet unable to say: but, with the small lamp which we use from one to ten feet below the surface, amphipods in great numbers, silver-sides, young bluefish, young lobster, squid, and flying-fish, have been induced into the nets, and dolphins have approached it; but whether the dolphins were attracted by the light, or were pursuing the squid, Professor Benedict, the naturalist of the ship, was unable to say. Squid are especially susceptible

to the influence of light. I am informed by the very eminent authority of Professor Ver-
rill, of Yale college, that a heavy sea, breaking upon a lee shore when the full moon is casting its rays across the land into the sea, will throw hundreds of squid upon the beach in a single night, — an evidence of their moving in the direction of the light until caught in the spray and hurled upon the shore.

To succeed in producing the light at considerable depths has been by no means easy.

The Edison company first prepared a lantern of two thicknesses of glass, hemispherical in form, with its flat side tightly joined to a bronze disk on which were placed three sixteen-candle power B lamps in multiple arc. At a moderate depth it burned beautifully; but at about a hundred and fifty feet the packing leaked, and the sea-water, entering, short-circuited, and the lamp was extinguished by the destruction of the cut-out plug. A similar lamp was then tried with improved packing; but its glass walls were crushed by the pressure of the water, and it was extinguished.

The next essay was with a single Edison lamp, its glass vessel being cylindrical in form, with hemispherical end, to give it strength; its thin platinum wires extending through one end without any external attachment. To these delicate wires I succeeded in soldering the copper wires of the cable, but broke (or cut) off one of the platinum wires at the point where it enters the glass, while putting on the insulation. When it is remembered that a hundred fathoms depth of water brings a pressure of over two hundred and fifty pounds per square inch on the lamp, it will be understood that great care was required in every procedure.

Our next attempt was with a single Edison lamp exactly the same as the last. I succeeded in soldering and insulating the joints perfectly; but the pressure of the water upon the insulation cut the delicate platinum wire on the glass before it had reached a hundred feet in depth.

The Edison company then produced a lamp in which the platinum wires were soldered to copper wires in a glass cavity, and filled in with rosin, so that copper wires, about no. 30 in size, projected from the lamp for our attachment. I coiled the copper wires spirally, and soldered their ends to the ends of the heavy wires of the cable, separating them by a small block of pine wood: this gave some freedom of motion, without danger of cutting or breaking the wires. A paper mould was placed round the joint, and filled with warm 'gulloot.' When



FISH-COMMISSION STEAMER ALBATROSS.
A SUBMERGED ELECTRIC LIGHT TO ATTRACT FISH, AND
ILLUMINATE THE WATER.

this had cooled, it was wrapped with insulation-tape, and served tightly with twine. This was again covered with gullot, then tape, and finally with melted gutta-percha; and, when the gutta-percha had cooled, its entire surface was seared over with a hot iron to make sure of filling any cracks or holes it might contain. The lamp was then lowered into the sea, about seven hundred and fifty feet of cable being paid out, without any indication of failure. To ascertain if the lamp was lighted at all times, we substituted a lamp for the cut-out plug in the deep-sea circuit. This brought both lamps in the same circuit, which caused them to glow at about a cherry-red instead of a white light; and had any accident happened to break the lamp in the water, or to cause a leak, our upper lamp would have immediately sprung into incandescent whiteness.

G. W. BAIRD,

Passed assistant engineer, U.S.N.

CRYSTALS IN THE BARK OF TREES.

In examining the interior of certain insects and myriapods living in and feeding on the wood and liber of decaying trees, the writer has often had his attention attracted by many beautiful and well-defined crystals mingled with the food-contents of the intestinal canal. The crystals appear to be insoluble in the intestinal juices, as they pass through the entire tract unchanged. Recently, in examining a large lamellicorn larva obtained from beneath the bark of a decaying white oak, I again observed an abundance of the same kind of crystals; and shortly after, numerous others were found in a *Polydesmus* taken from beneath the bark of a hickory log. Feeling sufficient interest in the matter to learn the source of the crystals, I examined a large white oak, dead and decaying, but still standing, with the bark loosely attached. On the inner side of the bark was a thick, yellowish-white, pulverulent layer, — the decayed liber. This readily crumbled to powder; and a small portion, diffused in water and submitted to the microscope, exhibited a multitude of crystals, forming the greater proportion of the powder, and of the kind previously noticed in insects. The crystals appeared perfectly fresh, and not changed by the surrounding decay, but were isolated, sharply defined, and highly lustrous. They measured from about the two-thousandth to the six-hundredth of an inch. Two forms were common, — simple, as represented in fig. 1; and twinned, as in fig. 2. A portion of the powder was submitted to my friend, Prof. F. A. Genth, for analysis, without informing him

as to its source. The report was, "It seems to be mostly calcium oxalate, with some carbonate and organic matter." The crystals pertain to the monoclinic system, like the mineral whewellite. In another decayed white oak examined, the pulverulent liber, of darker appearance than in the former, consisted of crystals, cellular *débris*, with no bast-fibres, but with numerous long, dark-brown, many-celled sporidia of a fungus, and a few dead rotifers. Under similar circumstances, the same kind of crystals, equally abundant, were observed in a dead chestnut-tree.

The liber of the fresh or undecayed white oak and chestnut exhibits the calcium-oxalate crystals arranged in close longitudinal rows, as

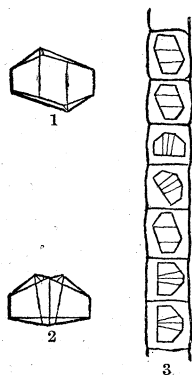


FIG. 1. — Calcium-oxalate crystal.

FIG. 2. — Twin form of the same. Both from decayed liber of the white oak, magnified 250 diameters.

FIG. 3. — Portion of a series of crystals from fresh liber, magnified 300 diameters.

represented in fig. 3, situated among the bast-fibres, and nearly as abundant. The crystals are smaller, approaching the ends of the series; and the spaces occupied by the latter taper at the extremities. Each crystal occupies a separate cuboidal cell, or at least a distinct compartment of a long fusiform space, bounded by the bast-cells. In the rows of crystals of the white oak, from twenty-five to thirty-five were counted, occupying a space of about the fiftieth of an inch in length. In the chestnut liber, from twenty-five to forty-five crystals were counted in different rows.

In the liber of the butter-nut the crystals are compounded in spheroidal clusters, and form rows arranged in the same manner as in the preceding trees.

Without having had any intention of investigating the occurrence of crystals in plants, I have been led to make the present communication on what, to botanists, may be a familiar fact, under the impression that many, like myself, have heretofore been ignorant of it; and this for the reason that sufficient notice of the matter has not been given. Our ordinary manuals, while referring to the occurrence of crystals in plants, and giving a few illustrations of those observed in herbaceous plants, take almost no notice of the beautiful forms in the inner bark of our forest-trees. The 'Micrographic dictionary' mentions the occurrence of raphides in the bark and pith of many

woody plants, as the lime and vine, but makes no reference to, nor gives illustrations of, such as occur in oaks, the chestnut, the hickory, etc. No more beautiful example of plant-crystals can be so readily obtained than that exhibited in thin slips of the liber of the oak or chestnut.

Although the occurrence of crystals in vegetable tissues was observed and described by Payen in 1841 (*Comptes rendus de l'académie des sciences*), the first and fullest account of the crystals of the liber of forest and fruit trees was given by Prof. J. W. Bailey, in a communication to the American association of geologists and naturalists, in 1843, afterwards published, with a plate, in the *American journal of science* for 1845, p. 17. Sanio subsequently described the same crystals in the *Monatsberichte* of the Prussian academy of sciences for 1857.

JOSEPH LEIDY.

THE PHYSIOLOGICAL STATION OF PARIS.¹—II.

THE black screen shown in fig. 4 is a kind of shed, three metres in depth, fifteen long, and four high. This height is necessary in photographing birds on the wing; for, on rising, they immediately leave the dark field. When the walk of a man or an animal is being studied, the opening of the screen is limited by a frame covered with black cloth suspended from its upper part: this regulates the ingress of light under the shed, and makes its cavity darker. In addition, a long strip of velvet two metres and a half broad fills all the lower part of this cavity. Thus the light coming through the bottom of the screen is almost entirely cut off.

In fig. 4 a man dressed entirely in white is walking before the dark screen. The course on which he walks is slightly inclined, in such a way that a visual ray, proceeding from the objective, passes very near the surface of the ground without meeting it anywhere. This is necessary in order that in the picture the feet of the walker may be entirely visible, while the ground is not: otherwise the light reflected from the ground would make an impression on the sensitive plate at the very points where the images of the feet should be produced, and make them obscure. The course is raised about twenty centimetres above the surrounding ground; and along the full length of this relief there runs a plank on which alternate divisions, each a metre and a half long, are painted black and white. The plank thus divided is seen in the photographs, and is useful in measuring the distance run between two successive images, and in estimating the size of the subject, the amplitude of his reactions, and the extent of displacement of each part of his body. In order to know the rapidity of movement, the time consumed in traversing the various spaces must be measured. Now, if the machinery which

¹ Concluded from No. 42.

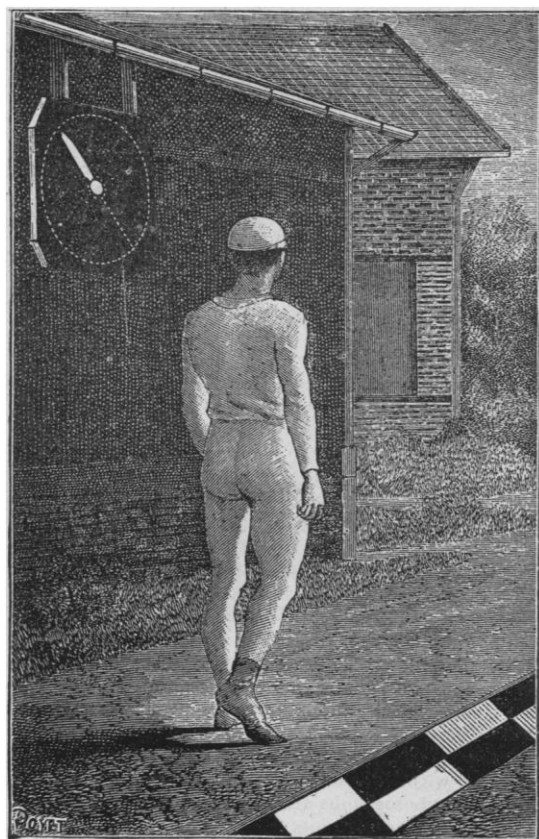


FIG. 4.

turns the disk always worked with the same speed, and if the number of openings were the same for all experiments, we should only have to determine once for all the interval of time which elapses between two images, and we should immediately have the expression of the rapidity: in short, if the successive illuminations were separated by one-tenth of a second, and if the interval in long measure between the images were five-tenths of a metre, it is evident that in one second five metres would be traversed. But the rapidity of the disk varies with the experiment: it must, then, be controlled. This control can be obtained by means of a chronograph which shall indicate the interval of time between the various turns of the disk during the experiment. But this method would give two kinds of independent indications, —that of the spaces on the photographic plate, and

that of the times on a revolving cylinder. It seemed to us better to obtain, also on the plate, the indications of the times elapsing between the successive images. This result was obtained in the following manner. In order to know the frequency of rotation of the disk, we have only to photograph the successive positions of a body moving with a uniform and known velocity. Fig. 4 shows, above the head of the walker, an apparatus which answers this purpose, and which we will call a *photographic chronograph*. It is a black velvet dial, on which bright nails, arranged in a circle, divide the circumference into a certain number of equal parts. A bright needle on the face of this dial is in continual motion, turning at the rate of a revolution a second. It is evident, that, if the disk of the photographic apparatus revolve only once a second, we shall have only one image of the needle on the dial; if the disk make six revolutions a second, we shall have six images, etc. Since the velocity of the disk is uniform, the images on the dial are separated by equal distances. These divisions allow us to easily estimate the fraction of a second corresponding to the interval between the images.

This method will be better comprehended if we consider its application. Fig. 5 represents a runner jumping a bar. The series of photographs commences at the moment when the leaper started on the preliminary spurt, and ends when the leap is finished, and the fall to the ground has partly destroyed the velocity. Let us analyze this figure. We see the subject represented nine times; that is, the disk revolved nine times during the experiment. Each rotation, bringing the opening of the disk in front of the objective, has permitted light to enter for a brief instant, which has sufficed each time to give an image. These successive images were produced at different points on the plate, because the leaper himself occupied different positions before the screen when each of the illuminations took place. The space traversed either on the ground

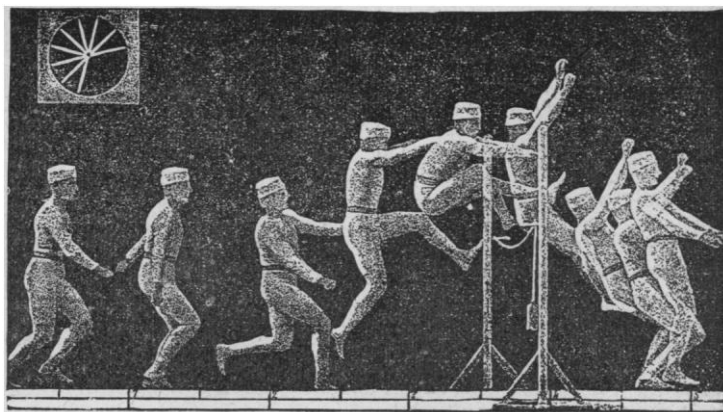


FIG. 5.

or in the air, between successive images, is easily measured by means of the divisions in the planks

seen at the bottom of the picture. We see that the interval is not always the same, and that, if we suppose equal intervals of time to separate successive images, the greatest velocity occurs in the run which preceded the leap, and that there was a diminution of speed while the leaper was in

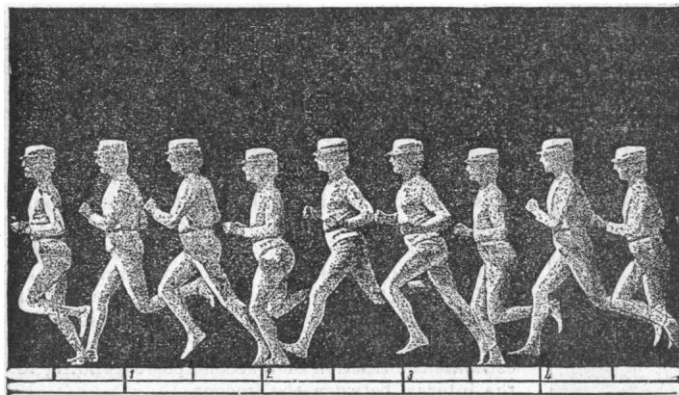


FIG. 6.

the air: in fact, this diminution is still increased after the fall, the velocity being partly lost the very moment the body touches the ground. In order to know whether the images have been produced at equal intervals of time, and the duration of these intervals, the dial of the chronograph must be consulted. It is then seen that the luminous needle is represented as many times as there have been illuminations, namely, nine times; that the interval between the illuminations was uniform, for the images of the needle whose rotation was uniform form equal angles: in short, the absolute value of the time-intervals between the illuminations is expressed by the angle which the images of the needle on the dial make. This angle is about 36° , which shows that the time-interval between successive illuminations is one-tenth of a second. From these measures of time and space we easily deduce the velocity of the leaper in the various phases of the experiment. This speed was seven metres a second during the preliminary run, five metres during the leap, and fell to three metres and a half after the fall.

When one takes on the same plate a series of photographs representing the successive attitudes of an animal, he naturally tries to multiply these images in order to know the largest number possible of the phases of movement; but when the latter is not rapid, the frequency of the images is soon limited by their superposition, and by the confusion which results. Thus, a man running even at moderate speed can be photographed nine or ten

times a second (fig. 6) without confusion of the images. If sometimes one limb is depicted where the other limb has already left an impression, this superposition does not at all affect the images: the white only becomes more intense where the plate has received two impressions, so that the contours of the two members

are still easily distinguishable. But when a man walks slowly, as in fig. 7, the images present so many superpositions that confusion results. This inconvenience is remedied by *partial photography*; that is, by suppressing certain parts of the image in order that the rest may be more easily distinguished. As by our method white and bright objects only make an impression on the sensitive plate, it is necessary merely to clothe in black the parts of the body which we wish to exclude from the image. If a man dressed half in white and half in black is walking on the track, and turns toward the photographic apparatus the part clothed in white, the right, for instance, there will appear in the picture

only the right half of his body. These images allow us to observe in their successive phases, first, the pivot-like turning of the lower limb around the foot during the time of support; and second, as the foot rises, the turning of the same limb around the hip-joint, while at the same time this joint is moving forward without cessation.

Partial photographs are also serviceable in an analysis of rapid movements, because by this means the number of attitudes represented may be many times

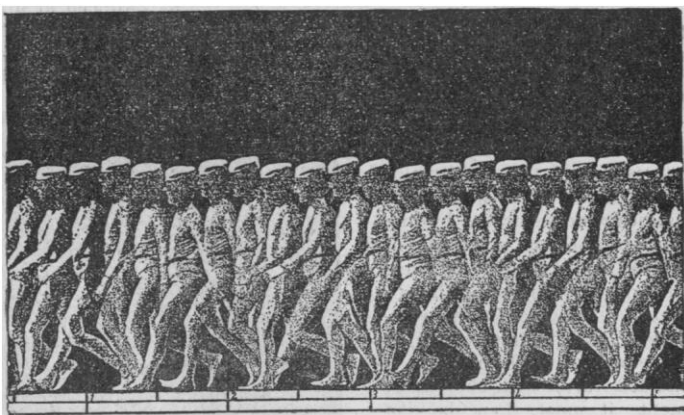


FIG. 7.

increased. Nevertheless, when the image of a limb is moderately large, the partial photographs cannot be too much increased without confusion through superposition. We must therefore diminish the size of the image, if we desire to repeat them at very short intervals. For this purpose the walker is clothed

wholly in black, and narrow bands of some bright metal are placed down his arm, thigh, and leg, following precisely the direction of the bones of these parts. This arrangement allows us to easily increase tenfold the number of images received in a given time on the same plate: hence, instead of ten photographs a second, we can obtain one hundred. For this, the rapidity of rotation of the disk is not altered; but, instead of one opening, there are ten, equally distributed on the circumference. One of these openings must have a diameter twice that of the others. The result is a much larger size for one of the images; and this renders the estimation of the time easy, and also furnishes data to compare the movements of the lower and upper limbs. The images obtained under these circumstances are so close, that one is present, as it were, at all the successive changes of place of the limbs and body. Thus, in fig. 8, between two successive touches of the ground by the right foot, there are twenty-one different positions of the lower limb. As the foot meets the ground, the knee is bent perceptibly; then it straightens as the foot, resting on the toes, prepares to leave the ground. After the raising of the foot, the knee bends again, and the leg forms with the thigh a right angle; then it gradually becomes straight, and the sole of the foot, which was at

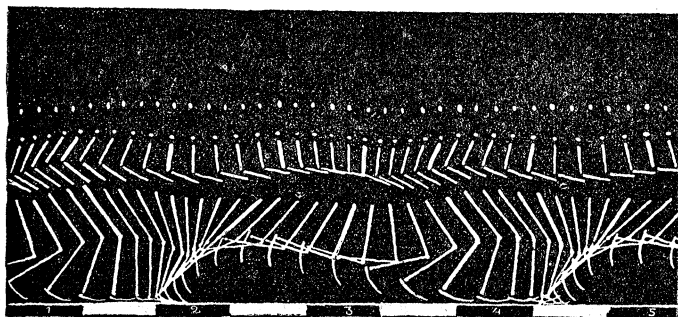


FIG. 8.

first in a vertical plane, is apparently parallel to the ground which it touches for some time before it rises again. The scale at the bottom of the figure shows that the total length of the step was 2.6 metres. The chronograph was not used in this experiment, but we may estimate the number of images at about sixty a second. The movements of bending and extending the fore-arm are obtained in the same manner as those of the leg. The turnings of the head are expressed by the undulatory motion of a bright point placed on a level with the ear. In short, the diminutions and the accelerations of each part are expressed by the crowding or separation of the images. To ascertain the corresponding positions of the arm and leg at a given instant, we take for data every fifth figure, which is larger than the others. These images are formed at the moment of passage before one of the larger openings; and they correspond, therefore, to the same instant of time. This is not the place to analyze in detail the various types of locomotion.

The few examples just given sufficiently explain the method, and show its exactness. For a complete study of human locomotion, photographs under the most diverse circumstances must be obtained. The subject must be photographed not only from the side, but also from the front and rear, in order to show the lateral oscillations of the different parts of the body. Finally, after studying the mechanism of the various motions produced in walking or running, the final result—the more or less rapid transportation of the man—must be studied, either as he walks freely, or as he bears or draws a burden.

These researches have a practical interest, even as those having for their object the determination of the product of machines, and the most favorable conditions for this production. Experiments in regard to this are in process; and it is with this object in view that the circular course with telegraphic signals, to note the phases of the walking or running, has been established.

THE FUNDAMENTAL CATALOGUE OF THE BERLINER JAHRBUCH.

A VERY important comparison by Dr. Auwers, of the fundamental catalogue of the *Berliner Jahrbuch* with those of the *Nautical almanac*, the *Connaissance des temps*, and the *American ephemeris*, appears as a supplement to the *Jahrbuch* for 1884; and the following abstract of it is given. The year 1883 is the first in which such a comparison is possible.

The *Berliner Jahrbuch* contains at present, and will contain for the future, 450 stars whose apparent places are given, and 172 stars for which only mean places are printed; i.e., 622 in all. The places of these stars, both in R. A. and Dec., depend strictly on the system of the Fundamental catalogue of the *Astronomische gesellschaft* (publ. xiv.). They lie between the north pole and $-31^{\circ}.3$ declination.

The *American ephemeris* contains the mean places of 383 stars, for 208 of which ephemerides are given: 44 of these stars lie south of -31° . The *Nautical almanac* has 197 stars (15 south of -32°), and ephemerides are given for all. The *Connaissance des temps* has 310 stars between the north pole and -70° , and gives an ephemeris for each.

Dr. Auwers's account of the sources from which the star-places of the various almanacs are taken we omit. It shows how various these are. 450 stars have ephemerides in the *Jahrbuch*; 149 stars (mostly southern) which have ephemerides in the three other almanacs are not contained in the *Jahrbuch*.

A table is given in Dr. Auwers's paper, showing the comparison between each star of each almanac and the *Jahrbuch*. From this table the elements by which the catalogue of each almanac can be reduced to the system of the *Jahrbuch* are deduced. A subsequent table gives the two reductions which must be added

to each almanac R. A., and the two reductions which must be added to each almanac Dec., in order to reduce to the system of the *Jahrbuch*.

The catalogue of each almanac, after the application of the systematic reductions from this table, is then compared with the Fundamental catalogue. For the *Nautical almanac*, the mean difference in declination is $0''.395$; in R. A. (from 134 stars), $0''.0332$. Of the 168 stars common to both almanacs, there are 27 whose R. A. differs more than $0''.067$, and 8 whose declinations differ by more than $1''$. These differences are, in the main, errors of the *Nautical almanac*, and are largely due to the erroneous proper motions adopted in the Greenwich catalogues.

For the *Connaissance des temps*, the table shows large systematic errors. After these have been eliminated, the comparison shows for 229 stars, common to the *Connaissance des temps* and the *Berliner Jahrbuch*, a mean difference of $0''.373$ in declination, and a mean difference of $0''.0282$ (from 162 stars) in R. A. The errors here, again, are largely due to erroneous proper motions.

The correspondence of the reduced positions of the *American ephemeris* with those of the *Jahrbuch* varies according as one or another basis of comparison is chosen. A complete comparison can only be made for those stars for which ephemerides are given, since the newer stars have their positions derived from several sources, not comparable among themselves.

The declinations of the *American ephemeris* and those of the *Jahrbuch* agree excellently for those stars which have been investigated by Boss. The mean difference (162 stars) is $0''.177$. The other 111 stars do not agree so well, there being 12 differences between $0''.5$ and $1''$. The stars north of 64° depend upon Gould's R. A.; and, of the 36 stars common to both almanacs, 15 differ by more than $0''.15$. Of the remaining 126 stars whose ephemerides are given, 8 have differences as great as $0''.067$. The mean difference for 100 stars between $+40^\circ$ and -20° is $0''.0127$. For the 111 stars without ephemerides, there are seven cases where the difference is more than $0''.067$.

For the stars south of -32° , the *Nautical almanac* will give the best positions, on account of its data being derived from the most recent catalogues.

A comparison of the system of the *Jahrbuch*, 1861-82, with the new system, and a general table for the reduction of the data of any almanac to the *Berliner Jahrbuch* system, concludes this very important paper.

It is to be hoped that in the immediate future all star positions may be reduced to the system of the *Jahrbuch*, and its admirable list of stars will be amply sufficient for observers in the northern hemisphere. For the determination of time and longitude, the stars of the other almanacs will serve a useful purpose, especially as they may easily be made homogeneous with the Berlin list by tables given by Dr. Auwers in this paper.

EDWARD S. HOLDEN.

Washburn observatory, University of Wisconsin,
Madison, July 24, 1883.

LETTERS TO THE EDITOR.

English *ch*.

IN SCIENCE, ii. 452, you assert that the English '*ch* (in *chair*) is not a simple consonant, but a compound,' consisting of '*t* followed by *sh*, as is apparent in pronouncing with 'due lingering emphasis' the words, 'even *such* a man, so woe-begone,' etc. Now, the same length and emphasis may be produced by a prolongation or continuous repetition of the vowel-sound of the word '*such*,' and, it seems to me, would be so in the case of anybody who was unacquainted with the *tsh* theory. But even if not, the change from a simple *ch* to a compound *tsh* would not be the only instance in the language, where under special circumstances, such as a prolongation or drawl, a sound is liable to an essential change; and it must be peculiarly so where the sound can be properly made only by an instantaneous movement. *Ch* seems to be caused by such a movement, just as a smack of the lips is, which is certainly a decidedly different sound from the one made in the same way, except more gently and slowly, — a *p* made with inward-drawn breath. The relation between the smack and that *p* seems to be the same as the relation between the English *ch* and *t*, and the difference in each case to depend on the mode of contact and of its interruption, not on any combination or succession of sounds.

Again: it appears quite possible to pronounce the word '*chair*' perfectly with the teeth kept slightly open by the finger or a pencil, and held, therefore, in such a position that it is impossible to pronounce the word '*share*' correctly, showing that *sh* is not properly a part of the *ch*.

Moreover, if *ch* is the same as *tsh*, or the German *tsch*, the Germans would at the outset have no difficulty in pronouncing the English *ch* in a way not noticeably different by its hissing sound from ours.

It has been said, that after pronouncing the word '*check*' to a phonograph, on turning the machine backwards, the sounds re-appear as *kesht*; but is that not wholly due to an incorrect, prejudiced pronunciation of the first word, as if written *tshék*? L. B.

Nov. 9, 1883.

[Argument is out of place in reference to what is a matter of mere observation. The suggested experiment by 'lingering emphasis' ought to satisfy any ear as to the reality of the stopped or shut commencement of the sound of *ch* in *chair*, and of its hissing termination. L. B. evidently associates some meaning different from the ordinary one with the terms 'simple' and 'compound.' *Ch* is compound because its shut commencement and its hissing termination are elementary effects, each of which is susceptible of separate utterance. — EDITOR.]

Report of the Assos meeting.

Henry W. Haynes, Esq., calls my attention to an error in the remarks on Assos made by me at the meeting of the Archaeological Institute, Oct. 31, and printed by you in your recent report (SCIENCE, no. 41).

For 'to fight against Ramses III. — the Rhampsinotos of Greek story,' read, 'to fight against Ramses II. — the Sesostris of Greek story.'

May I beg you to make this correction public.

JOSEPH THACHER CLARKE.

Boston, Nov. 19, 1883.

Analysis of the wild potato.

In the spring we received from Mr. J. G. Lemmon, Oakland, Cal., some tubers said to be of *Solanum tuberosum*, var. boreale, and collected in Arizona. Of

thirteen tubers planted May 4, nine furnished plants, which bloomed July 12, and in September ripened a crop of tubers no larger than the seed planted, or of the size of small hazel-nuts. The leaves were small, deep grayish-green above, not hairy; the stems, much branched, deep purple at the nodes; the flowers, white and numerous. The tubers were very diffusely spread in the soil.

An analysis of the tubers harvested by the station chemist, Dr. S. M. Babcock, is as below:—

Water	64.44
Ash	1.17
Albuminoid (N. $\times$ 6.25)	4.86
Crude fibre	.78
Nitrogen (free extract)	28.62
Fat (ether extract)	.13
	100.00

E. LEWIS STURTEVANT, *Director*.

N. Y. agricultural experiment-station,
Geneva, N.Y., Nov. 14, 1883.

Musical sand.

In September (no. 31) you published a brief abstract of our preliminary paper on the singing-beach of Manchester, Mass. Since then we have continued our investigations, and collected additional data and material. One of us has just returned from a visit to the singing-beach on the west shore of Lake Champlain, four miles and a half south of Plattsburg, Clinton county, N.Y. This beach is about seven hundred feet long, crescent-shaped, and terminates at the south end in low cliffs of limestone, and at the north end in shelving rocks of the same material. About a hundred feet north of the beach the limestone is quarried for building-purposes.

The acoustic phenomena previously described in connection with Manchester and Eigg are reproduced at Lake Champlain quite perfectly. On the occasion of our visit, however, the sand retained traces of moisture, and the noise, indicated by the syllable *groosh*, was less strong than it would otherwise have been. Two tests, however, showed that the sound made by rubbing the sand with the hand, and pressing it on the strata below, could be heard distinctly at a distance of more than a hundred feet. The tingling sensation in the toes, produced by striking the sand with the feet, was also perceived. We failed, however, to obtain sounds by rubbing the sand between the palms of the hands,—a method which yielded remarkable results at Manchester and at Eigg; but this failure is doubtless due to the imperfect dryness of the sand. Having learned, by experience with samples from the aforesaid localities, that they lose their acoustic properties after repeated friction, we tested this question directly on the beach. We found, that, by rubbing a definite quantity of sand continuously, its power of emitting sounds gradually diminished, and finally ceased.

The sand is unusually fine, and its grains of remarkably uniform size, averaging about 0.2 millimetre in diameter. Even to the naked eye their tendency to a spherical shape is apparent; and, when examined under the microscope, they are found to consist, to the amount of about thirty per cent, of round and polished grains of colorless quartz, usually of spherical, ellipsoidal, and reniform shapes; about the same quantity of angular to subangular grains of the same mineral, colorless, reddish, and yellowish, sometimes enclosing scales of hematite, grains of magnetite, and fluid cavities; a considerable number of fragments of a triclinic felspar, angular to subangular, colorless, and sometimes exhibiting cleavage-planes, and

lines of striation; many short fibres and fragments of hornblende, and apparently augite, of a deep green color, often irregularly colored reddish brown by decomposition, and possessing strong dichroism; and a few minute particles of menaccanite and magnetite.

In conclusion, we will be greatly obliged to any reader of SCIENCE for information of additional localities of sonorous sand, and especially for samples for microscopical study.

H. C. BOLTON and A. A. JULIEN.

Nov. 19, 1883.

November shower of meteors.

Watch was kept here for the November shower of meteors by myself and a number of students on the mornings of the 13th and 14th,—on the 13th from 2 to 4, on the 14th from 2 to 6. The observers were in a room having southern and eastern exposures, and meteoroids were looked for only in those directions. It was quite cloudy on the 13th, and only one meteoroid was seen; nearly clear on the 14th; and considering the fact that the moon was nearly full, and stars of the fourth magnitude could not be seen without attention, more meteoroids were seen than were expected, nearly all coming from the radiant in Leo. Owing to the fact that their appearance was not frequent enough to maintain constant attention, it is likely that most of those which were near the limits of visibility escaped observation. The maximum seemed to be at about 4.30. At 3.20 a very brilliant one, much exceeding Sirius in brilliancy, was seen.

Michigan agricultural college.

L. G. CARPENTER.

SOME RECENT STUDIES ON IDEAS OF MOTION.

Studien über die bewegungs vorstellungen. Von Dr. S. STRICKER, professor in Wien. Wien, Braumüller, 1882. 6+72 p. 8°.

THESE studies are efforts in experimental psychology, with accompanying speculations, by a physiologist who has already written upon like subjects in his 'Studien über das bewusstsein.' The style is fragmentary, and not always very clear; and there are some confusing efforts to frame a new terminology. Above all, the author's training in general philosophy is very imperfect; and therefore what he says in the latter half of this essay, 'Ueber die quellen unserer vorstellungen von der causalität,' is almost wholly antiquated and insignificant, having been superseded ever since Hume, whom, in fact, our author seems in one respect to have wholly misapprehended. But in his direct observations of mental facts, Professor Stricker attracts one's attention as having given some independent contribution to the discussions about the relation of the muscular sense to our ideas of motion. Even here, it must be remarked, he pays little attention to the fact that others have been at work before him, and seems to think his ideas quite new. Yet what he has done is to observe, and record his observations; and in so far forth he has done what we want done in the psychological field.

Professor Stricker asserts that practice in the use of his muscles, and especially in the training of the muscular sense for mechanical purposes, has rendered him uncommonly well qualified to note the presence of muscular sensations as elements in any complex state of mind. Some of his colleagues have like skill. He has thus been led to pay attention to facts such as, that, when he perceives the movements of another person, or remembers these movements clearly afterwards, or deliberately imagines a movement of a man or even of an animal, he always is aware of a slight feeling of effort in those muscles of his own body that would be concerned in the same or in some analogous movement. The appreciation or conception of a bodily movement is thus accompanied by a more or less well-marked dramatic imitation of the movement. Again: if he perceives or conceives the visible motion of a body in space, he is conscious of a motion, or of a tendency to motion, in the muscles of the eye. These personal observations he finds confirmed by others in proportion to their training in introspection, and in the special observation of the muscular sensations. In watching the motions of many small objects at once in the field of vision, as in case of a snow-storm, the author is not quite so fortunate. "I find difficulty," he says, "in discovering any trace of motions of the eyes; yet, after long exercise, I have now no longer the least doubt that I follow the single flakes with small and quick motions or nascent motions of the eyes" (p. 23). In case, however, of an effort to picture in memory just how a snow-storm looks, the author either finds himself picturing a stationary mass of flakes, or else following in mind the motions of single flakes. In the latter case he discovers that the muscles of the eyes are perceptibly innervated. The result, therefore, notwithstanding the difficulty, is in the end the same.

In the case of the illusions of motion in the 'wheel of life,' the author asserts that the illusion is always accompanied by motions of the eyes, and that it is impossible without such motions.

His conclusion from all this is, that "motion is conceivable only in connection with, and by means of, the muscular sense," — a result that, in this extreme form, probably very few investigators will accept. Certainly Professor Stricker has not proved it; since he has, on the one hand, left very numerous facts wholly unnoticed, and, on the other hand, has adduced facts that are of doubtful force for his purpose. As for the omitted facts, a reviewer of this book

in the *Philosophische monatshefte* has challenged Professor Stricker to show what part the muscular sense plays in the perception of the motion of an object seen double in indirect vision, when the eyes are fixed on some chosen point. Thus, if one's gaze is fixed directly in front on some bright point, or on one of the eyes of the observer's own face as seen in a mirror, so that the eyes are surely at rest, then the finger, or a pencil, held up so as to appear double, will yet in both its shadowy images be seen to move when the real finger is moved, or when the pencil is moved by an assistant without the observer's previous knowledge. Yet here, says the reviewer, the double images show that the eye does not follow the motion at all, else they would coalesce. And if the mirror is used, the observer, looking at his own eye in the mirror, can be doubly sure that his eyes are motionless. This objection, however, is not so near at hand as another, mentioned by the same reviewer, — the one that must at once occur to any reader of Professor Stricker's book; viz., the case of the motion of some small object over the skin, say a crawling insect. Here the motion is felt as motion, and not as mere tickling, as soon as the requisite speed and amplitude are attained. What has the muscular sense to do here?

But, obvious as these objections are, they are not final. Professor Stricker might reply, that, according to Lotze's own suggestion, the now well-recognized *localzeichen* themselves may be of the nature of muscular impulses. In the retinal field the tendency to bring any point of attention into the point of sight may exist universally; and the motion of the indirectly seen finger over the resting retinal field may be known by reason of the change in the magnitude and direction of the effort that during the experiment constantly exists, to bring the finger, as the object most attended to, into the point of sight. Something analogous may make possible the perception of the motion of a point on the skin. But these are hypotheses. They are doubtful; and they require of Professor Stricker supplementary investigations, whereof he seems to have had no thought.

There remain, however, the cases of what a late writer in the *Wiener sitzungsberichte* (Fleischl, *Optisch-physiol. notizen*, no. vi., in bd. lxxxvi., i., for 1882) has called *bewegungsnachbilder*, which have long been observed and discussed. These are the subjective appearances of motion in the visual field, after the continued observation of swiftly-moving real objects; as when one has been looking at

a waterfall or at a rotating-disk. Helmholtz, indeed, explains all these appearances together as visual vertigo; putting them with the phenomena of apparent motion in dizziness, and regarding them as all alike caused by motions of the eyes, unconsciously continuing after the cessation of the observation of the objective motions. Yet Helmholtz has trouble to apply this explanation, whose validity in its own class of cases is undoubted, to the case where contrary motions appear in the field of vision at the same time; and Hering, in Hermann's 'Handbuch der physiologie' (iii., i., 562), insists for these cases on the rival explanation, "Die scheinbewegung beruht auf einer localen reaction des sehorganes gegen die vorangegangene erregung." Thus we should have true spectra of motion.

One may add, that the recent article by Drs. H. P. Bowditch and G. Stanley Hall in the *Journal of physiology*, vol. iii., p. 297 sqq., leaves no room to doubt that optical illusions of motion of this class do exist, that cannot be explained as resulting from visual vertigo, and that can properly be called *bewegungsnachbilder*, at least until we know more about them.

If, now, the explanation of Helmholtz is not sufficient for all cases, if there are any cases of true *bewegungsnachbilder*, then surely they cannot be brought in any wise under Professor Stricker's extreme theory without a simply appalling mass of hypotheses. Such cases are insisted upon by Fleischl in the note above cited; and he even notes the curiously contradictory character of the spectra of motion,—the presence in them of a motion, without any actual transference from place to place that the eye *can* follow. They excite him to the rather petulant outburst with which his note closes; viz., that *empfindungen* are fundamentally illogical, and that the principle of contradiction does not hold good for them, but only for their more developed relatives, the *vorstellungen*. Perhaps, however, our author will insist that it was of *vorstellungen* only that his studies treat, and that with such wicked and illogical *empfindungen* as Fleischl's *bewegungsnachbilder* he has nothing to do. Yet, if his theory is to be complete, he must not be allowed to shrink from its applications. What can he do with the own cousins of these illogical phenomena, namely, the chaotic sensations of the darkened visual field? Here is for some eyes, such as the present reviewer's, little more than motion or change, without any power of distinguishing what it is that moves. So it is with Mr. Galton ('Human faculty,' p. 159). Helmholtz himself describes, in his own case,

motions of 'two systems of circular waves advancing towards their centres;' and so, of course, there must be for him, in the darkened field, motions at the same time in contrary directions, that cannot well be explained as the result of muscular efforts. A similar experience is described by Professor LeConte (in his book on 'Sight,' p. 72); and Purkinje's observations, as Helmholtz gives them, are also to this effect. In all these cases, then, we have motions—whether manifold and confused, or definite and regular—which, it would surely seem, cannot be explained as resulting from, or in any way implying, muscular sensations. These cases, then, lie wholly out of Professor Stricker's range.

Yet possibly it may not seem to most readers worth while to spend time in refuting the hasty generalization of our author. But the object here is to suggest both the necessary limitation and the possible scope of this theory of the ideas of motion. Its limited scope seems clear, but its very one-sidedness is instructive if we look a little closer. It is one-sided, for instance, in the inductive methods used. In case of the mental picture of the snow-storm, Professor Stricker found his theory in danger of failing: so he followed the single snow-flakes with the mind's eye; and lo! the theory is verified, and so throughout. The influence of attention upon the result is so plain, that the reader must have noticed the fact in reading our previous summary of the book; and yet this formal error in the reasoning does not make the result wholly erroneous. If one takes note in himself of the facts upon which such stress is laid by our author, one will very readily find that there is at least this in them; viz., every clearly conceived or perceived objective motion tends, just in proportion to the *clearness and definiteness* of perception or of conception, to become associated with a certain kind, degree, and direction, of muscular effort. That muscular efforts are involved in mapping out the visual field; that we follow every point in whose motion we take special interest, and are partially conscious of what we do in following it; and that analogous facts exist for the sense of touch,—are truths now generally recognized. Professor Stricker is interesting as having given us an independent, and, in so far forth, unprejudiced, contribution to the theory. That it has charmed him over-much is itself a fact of interest for the theory: for it shows how much clearer and better Professor Stricker seemed to himself to have conceived motions, when he had brought their conception into immediate connection with the facts of the muscular

sense; that is, we see hereby how the muscular sense, used as the *measure of the amount of our activity*, is for that reason the especial means of helping us to build up definite ideas of complex facts. Motions we could know, it would seem, apart from the muscular sense; but we should have no such clear ideas as we have of the differences among motions. Even so it probably is with space. We should know of space if we were motionless; but we should not know of what Mr. Shadworth Hodgson calls figured space, — space mapped out as the mathematician needs to map it out. In fact, the connection of the muscular sense with the simple perception of movement, to form the complex perception of the definite character of the manifold differences between one movement and another, gives us an excellent illustration of that general law of mind according to which as many originally separate mental facts as possible are constantly being brought together, in order that, from their blending, a new and more definite unity may come. Increased complexity of data running side by side with increased simplicity of form, — this is the law of mental progress; and so the motions perceived by the pure sense of touch become definitely comparable with one another, and with the motions of the pure sense of sight, by means of the union of both with the data of the muscular sense, the whole thus forming the basis for higher rational mental processes.

Professor Stricker's facts are also useful as independent illustrations of certain other allied laws that have been elsewhere recognized. For instance: the tendency to join the conception of a motion with an imitation or nascent imitation of this motion has been before illustrated by the phenomena of hypnotism, by the gestures of sensitive and vivacious people, by the facts of so-called 'mind-reading,' and by many similar and very common experiences. Professor Stricker has attended more to these imitative tendencies than most people are accustomed to do, and has verified them subjectively for himself. Mr. Galton's 'histrionic associations' ('Human faculty,' p. 198) belong to the same group of facts.

Another law, however, is indirectly verified by Professor Stricker, as far as his observations go; and it may be well to mention this law here, because, so far as the present writer knows, little attention has been devoted to it by psychologists. It is the law formulated as an aesthetic principle in Lessing's 'Laocoön,' that moving objects, actions, events, can be properly described by the poet in language; while things that have to be spoken of as rest-

ing, and, in general, things that are coexistent, cannot successfully be represented by language. Still more generally stated as a practical principle of the rhetorician, the law is, that, to describe vividly, one must seize upon every element in the object that can be spoken of in terms of motion or action, and must either neglect or very briefly indicate whatever elements cannot so be interpreted. This principle explains one use of personifications, whether total or partial. The mountains rise into the sky, or lift their heads; the lake stretches out before one's sight; the tower looms up, or hangs over the spectator, — such are some of the more familiar devices of description. An exception that illustrates the rule is found in the case of very bright colors, whose interest and comparative brilliancy in the mental pictures of even very unimaginative persons may make it possible for the descriptive poet to name them as coexistent, without suggesting motion, particularly if he render them otherwise especially interesting. So in the well-known description, in Keats's 'St. Agnes' eve,' of the light from the stained-glass casement, as it falls on the praying Madeline. Even here, however, the light *falls*. And color-images, however brilliant, are increased in vividness by the addition of the suggestion of motion; as in Shelley's 'Ode to the west wind,' where

"The leaves dead
Are driven like ghosts from an enchanter fleeing,
Yellow, and black, and pale, and hectic red,
Pestilence-stricken multitudes."

Much less effective would be the mention of the most brilliant autumn hues apart from motion.

Lessing gave as basis for this theory the somewhat abstract statement that language, being spoken or read successively, is best fitted to portray the successive. But this is hardly the whole story. The modern generalization that men and animals alike observe moving more easily than quiet objects, in case the motion is not too fast or too slow, seems to come nearer to offering an explanation. But this account is still incomplete; for it will be found that we do not always picture mentally the motion of an object, even when we try to do so. To see a man walk in the mind's eye is not always so easy as to picture a man in some attitude. Professor Stricker notes that his dreams seldom picture to him actual motions. In many dreams we must all have noticed that the rapid transitions that take place are rather known as motions or alterations that have happened, than as changes in

process of taking place. The present writer's own image with Shelley's lines above quoted is not so much of dead leaves actually moving, as of the leaves rustling, with the sense or *feeling* that they are driven by the wind. The words descriptive of motion give, rather, the feeling of action connected with the leaves, than a picture of movement itself. So, to say that the mountains *rise* is to direct the mental eye upwards, rather than to introduce any picture of objective motion into the mental landscape. So, then, it seems probable, that, while we notice moving rather than resting things, our mental pictures tend to be representations of resting attitudes, rather than pictures of motion. And the greater vividness which descriptions of motion nevertheless possess would seem to be due to the sense of activity that they introduce into our ideas of the objects; and that this sense is connected with the muscular sensations that we are accustomed to associate with all clearly perceived motions seems both probable in itself, and in some wise confirmed by Professor Stricker's observations. The whole leads us, in fact, to another probable

law of mental life; viz., that, since an animal's consciousness is especially useful as a means of directing his actions, the ideas of actions, however they are formed, will naturally be among the most prominent elements of the developed and definite consciousness. We need not make any assertion about the direct source of these ideas. Whether the active muscular sense is a direct consciousness of the outgoing current, or a true sense through the mediation of sensory nerves, the result will not affect either Professor Stricker's argument or our own suggestions.

In conclusion it may be well to say, that, if psychology were already a developed experimental science, such independent and hasty observations and generalizations as our author's would hardly be worth discussion. But as things are, even very imperfectly conducted observations, if they are direct and sincere, must be thankfully accepted. Something of the same sort may possibly hold good of the similarly hasty suggestions that have here been thrown together.

JOSIAH ROYCE.

WEEKLY SUMMARY OF THE PROGRESS OF SCIENCE.

MATHEMATICS.

Algebraical equations.—M. Walecki, in a note presented to the Académie des sciences by M. Hermite, gives a proof of a fundamental theorem in the theory of algebraical equations; viz., that every algebraical equation has a root. The theorem being evident for real coefficients, M. Walecki assumes the coefficients as imaginary, and writes the first member of the equation in the form $P + iQ$, and also makes $F(x) = P^2 + Q^2$. He considers first the case of an equation of odd degree, say p ; then it is only necessary to prove that the equation $F(x) = 0$, of degree $2p$, has a root. To do this, he writes $x = y + z$, and distinguishes the odd part in z from the even part in the development of $F(y + z)$, writing thus: $F(x) = \phi(z^2) + z\psi(z^2)$. The resultant of ϕ and ψ is shown to be a real polynomial of odd degree in y , and vanishing for a real value of y . Two cases present themselves: viz., one of the functions ϕ or ψ may vanish identically; and this can only be ψ , for the coefficient of the term of highest degree in ϕ is not zero. Then, ϕ being of odd order, $F(x)$ has a real divisor of the second degree. The second case is when ψ is not identically zero, and when ϕ and ψ have a common divisor, $F(x)$ being then decomposed into the product of two factors. The author shows, then, that in either case a divisor of $F(x)$ is obtained of either the first or second degree, and with real coefficients; thus proving the proposition for an equation of odd order. A similar investigation is given

for equations of even order. — (*Comptes rendus*, March 19.) T. C. [409]

A differential equation.—M. l'abbé Aoust has here given a method for obtaining the formula giving the general integral of the differential equation—

$$x^n \frac{d^n y}{dx^n} + A_1 x^{n-1} \frac{d^{n-1} y}{dx^{n-1}} + \dots + A_n y = F(x),$$

by aid of a certain multiple definite integral. The quantities $A_1, A_2, \dots, A_n$ are constants. He proposes first to solve the problem of finding a function, ϕ , in terms of another function, ψ ; the two functions being connected by the relation—

$$\psi(x) = \int_0^1 da_n \int_0^1 da_{n-1} \dots \int_0^1 da_1 \phi \left(a_n^{\frac{1}{a_n}} \dots a_1^{\frac{1}{a_1}} x \right).$$

The process for the reduction of this is by substituting

successively z_1 for $a_1^{\frac{1}{a_1}} x$, z_2 for $a_2^{\frac{1}{a_2}} z_1$, etc.; and finally the expression of ϕ in terms of ψ is obtained. The transition from the solution of this problem to the solution of the problem of finding the general integral of the given differential equation is then indicated, and the integral given in the form—

$$y = \sum_1^n M_i x^{a_i} + \frac{1}{a_1 a_2 \dots a_n} \int_0^1 da_n \int_0^1 da_{n-1} \dots \int_0^1 F(a_n a_{n-1} \dots a_1 x) da_1.$$

The quantities $M_1, M_2, \dots, M_n$ are arbitrary constants, and a_1 , etc., roots of a certain algebraical equation. — (*Comptes rendus*, March 19.) T. C. [410]

ENGINEERING.

Effect of frost upon fire-plug casings.—Mr. Allen J. Fuller referred to a general impression that the freezing of the earth around fire-hydrants has a tendency to gripe fast to the frost-jacket, and lift it with the expanding or heaving earth, which he denied for the following reasons. 1°. The frozen earth slides on the surface of the frost-jacket, because its expansion is greater than that of iron. 2°. As the expansion of the earth must be in proportion to the intensity of the cold, so will it be greater above than below a given point: therefore the first foot of frozen ground will have a greater upward movement than that which is below it, and the second foot greater than the third, etc. Thus it will be seen that the earth below a given point rises more slowly than that above, and its friction is opposed to the one above. 3°. If this is true of feet, it is true of inches and of portions of an inch: therefore there is a retardation movement throughout. 4°. The upward movement of the ground: the freezing being greatest towards the surface, and such movement involving a more complete fracture of the earth surrounding the frost-jacket, it follows that the friction is less at this point than that below it, and in consequence there is less power to move upward than downward. Of course, the above does not apply to any construction that the frost can get beneath.

Mr. Frederic Graff noted and described the form of wooden casing which had been successfully used in the early practice of the Philadelphia water-department.

In response to the theory advanced in regard to the action of frost in raising the casings of fire-plugs, and to the statement that if the base of a structure extended below the frost-line it would not be lifted, Prof. Haupt remarked, that he thought the theory was in part sustained by the fact observed by some of the district surveyors, and verified by the accurate measurements they were obliged to make, that fences moved bodily to the south and east in consequence of the action of the sun and frost upon the ground on opposite sides of them. He thought, also, that the deductions concerning the immobility of structures resting below the frost-line were not fully sustained by the facts; as in the north-west, where ice forms rapidly, he had heard of numerous instances of piles driven for bridges, and extending some distance below the frost-line, having been raised as much as five to six inches in a single night; and he conceived the action in this case to be similar in kind to that of piles driven entirely through solid ground, the only difference being in the *amount* of the resistance offered by friction and weight of pile. The water, in freezing around the pile, acts upon it as a griper or vice; and the expansion of the various strata or laminae of water, as they become converted into ice, acts as a lever to force up the pile.

Mr. Howard Murphy did not consider the case cited by Prof. Haupt as parallel, as the so-called piles, being driven through water and soft mud, were probably columns resting upon their bases, and depending but little upon the frictional resistance of the mate-

rial through which they passed. Therefore the expansive force upward of the freezing water would be opposed by little more than the weight of the pile; whereas in a fire-hydrant casing, or other deeply planted post, the presumably well-rammed material around the whole length under ground would offer such proportional frictional resistance as to cause the freezing earth to slide up the post rather than to lift it. If the ice could be supposed to act downwards upon the piles in question, it is hardly likely that it would have forced them farther home. — (*Eng. club Philad.*; meeting Nov. 3.) [411]

An enormous steam ferryboat.—The Solano, on the Central Pacific railroad ferry, between San Francisco and Oakland, Cal., was built by the Harlan & Hollingsworth company of Wilmington, Del. The boat is 494 feet long on deck, 406 on the water-line, 116 feet beam, 6½ feet draught, loaded. The tonnage is given as 3,540. The engines are two in number, beam-engines working independently, having cylinders 62½ inches in diameter, and of 11 feet stroke of piston. These engines are each rated at 2,000-horse power. The boilers are 8 in number, of steel, have 19,630 square feet of heating-surface, or about 1,500-horse power according to a usual rating (12 square feet to the horse-power). The wheels are 30 feet in diameter, and are fitted with 24 buckets. There are four lines of rails on the deck; and 48 freight or 24 passenger cars can be carried at once. — (*Mechanics*, July 28.) R. H. T. [412]

Surface-condensers for marine engines.—Cadet engineer J. M. Whitham, U.S.N., compares the performance of surface-condensers of marine engines with the results of a formula for required area of surface constructed by him, and deduces a constant for usual application. He obtains the expression, —

$$S = \left\{ \frac{L}{T_1 - t} + \log_e \left(\frac{T_1 - t}{T_2 - t} \right) \right\} \frac{W}{c k},$$

in which

S = square feet of condensing-surface,
 W = pounds of steam condensed per hour,
 L = latent heat of steam of temperature, T ,
 T_1 = temperature of exhaust-steam,
 T_2 = temperature of feed,
 t = mean temperature of circulating water,
 c = coefficient variable with efficiency of surface,
 k = conductivity of the metal (556.8 for brass, 642.5 for copper).

He finds the usual value of c to be 0.148. He finds that this figure may be increased ten per cent where independent circulating pumps are used. The common value of $c k$ is taken as 82.2252. An inspection of the table of areas in use indicates that the smallest areas are very nearly as efficient, as a rule, as the greatest. — (*Proc. naval inst.*, ix. 303.) R. H. T. [413]

Protection of iron from rust.—As it has been observed that iron embedded in lime-mortar is hindered from rusting, Riegelmann of Hanau uses a paint containing caustic alkaline earth (baryta, strontia, etc.), so that the iron may be protected as it is by lime. The *Neueste erfindung* states that a mixture

of ten per cent of burnt magnesia, or even baryta or strontia, mixed cold with ordinary linseed-oil paint, and enough mineral oil to envelop the alkaline earth, will protect iron by its permanent alkaline action, the free acid of the paint being neutralized. — (*Build. news*, Sept. 14.) C. E. G. [414]

Asphalt mortar. — A composition of coal-tar, clay, asphalt, resin, litharge, and sand, an artificial asphalt, has been used for some years with perfect success on the Berlin-Stettin railway for wall-copings, water-tables, and similar places requiring a water-proof coating. It is applied cold, like ordinary cement. The space to be covered is thoroughly dried and cleaned, and then primed with hot roofing-varnish, the basis of which is also tar. The mortar is then spread cold with the trowel, to a thickness of three-eighths of an inch. If the area is large, another coat of varnish is given, and rough sand strewn on. The material is tenacious, impregnable to rain or frost: a piece exposed four years to the drainage of a slope thirty-three feet high is perfectly sound, and has required no repairs. — (*Centr.-blatt. bauverw.*) C. E. G. [415]

AGRICULTURE.

Relative value of soluble and reverted phosphoric acid. — Experiments by Voelcker gave no result, the differences between the unmanured plots being greater than those between manured and unmanured plots. Wildt, in experiments in five different places, found in one case that the soluble form gave the greatest increase, in three cases no effect could be observed from the phosphoric acid in any form, and in one case the results were contradictory. — (*Biedermann's centr.-blatt.*, xii. 514.) H. P. A. [416]

Influence of quality of seed upon the crop. — One of the most important conditions of a successful vegetation experiment is uniformity in the seed used. With this in mind, Hellriegel has investigated the effect of variations in the absolute weight, and in the specific gravity of seeds upon the growth of the resulting plants. He finds, that, of seeds (of barley) having the same specific gravity, the heavier seeds produced at first more vigorous plants than the lighter. As the plants continued to grow in good soil, the differences gradually diminished, until, at the time of harvest, they had entirely disappeared. When the plants grew in poor soil, the effect of differences in the seed was more lasting, and even affected the total weight of the crop. Differences of specific gravity in seeds of the same weight produced no recognizable effect upon the crop. The stage of ripeness of the seeds affected the development of the plants in the same direction as it did the absolute weight of the seeds; the riper seeds being heavier, and producing the most vigorous plants, and the differences being most manifest on a poor soil. Essentially the same results were obtained in experiments with potatoes. The attempt was also made to raise potatoes of greater or of less specific gravity, by selection; the heaviest or lightest being continually selected for seed. The experiment was continued through three seasons, with a negative result. — (*Ibid.*, xii. 530.) H. P. A. [417]

MINERALOGY.

Albite. — This mineral usually occurs somewhat impure, owing to the presence of small quantities of potassium and calcium. C. Baerwald claims to have found for the first time a perfectly pure albite from Kasbék, Caucasia, in which no trace of potassium or calcium could be detected, and which yielded, on analysis, SiO_2 (68.75). Al_2O_3 (19.73). Na_2O (12.29) = 100.77; gravity, 2.618. This albite is regarded as of special interest in relation to Tschermak's theory, that the soda-lime felspars are all isomorphous mixtures of a pure soda felspar (albite, $\text{Na}_2\text{Al}_2\text{Si}_6\text{O}_{16}$) with a pure lime felspar (anorthite, $\text{CaAl}_2\text{Si}_2\text{O}_8$), giving a continuous series between the two extremities which vary in physical properties. Pure albite not being known, an idea of its properties was arrived at by calculation, and the author regards it of interest to compare the albite from Kasbék with the theoretically pure albite of Tschermak.

FOUND ON ALBITE FROM KASBÉK.		CALCULATED BY TSCHERMAK.	
Gravity	2.618		2.624
Angle of base on brachypinnacoid,	86° 22'		greater than 86° 29'

When examined with crossed nicols and sodium light, the extinction upon a basal section was found to be $2^\circ 17\frac{1}{2}'$ on either side of the twinning-plane; and, with a section parallel to the brachypinnacoid, the extinction took place at an inclination of $18^\circ 23\frac{3}{4}'$. These values vary considerably from those arrived at by Schuster, respectively $4^\circ 30'$ and 19° ; but the author regards his values as especially correct, being obtained by experiment on pure material, and not by calculation. — (*Zeitschr. kryst.*, viii. 48.) S. L. P. [418]

GEOGRAPHY.

(Arctic.)

Population of the Chukchi peninsula. — Dr. Aurel Krause gives a *résumé* of the exploration of this district from the middle of the seventeenth century, and a discussion of the ethnic relations of its people, largely from the observations of himself and brother during their late travels. To this is added a small ethnological map, showing the distribution of the various stocks on either side of Bering Strait; and a valuable vocabulary, chiefly of Chukchi words, but containing also some words of the Asiatic Eskimo, and some recognized as jargon. — (*Deutsche geogr. blätter*, vi. 3.) W. H. D. [419]

Hydrography of the Siberian Sea. — Otto Pettersson contributes to the second volume of the 'Scientific results of the Vega expedition' a study of this subject, illustrated by charts of the Kara Sea, and of that part of the Arctic Ocean between Novaia Zemlia and Bering Strait which has been named the Norden-skiöld Sea. An important part of the paper consists in the discussion of the movements of the ice in the Kara Sea, which, the author concludes, depend less on wind and weather than on the varying amount of warm surface-water which enters the Kara basin in different years. This warm water depends largely upon the discharge of the great Siberian rivers, and differs according to the time when the ice in them

breaks up in different years. As a complement to this investigation, may be mentioned a paper on Nordenskiöld's explorations, printed by Fr. Schmidt of the St. Petersburg academy of sciences, in which the author endeavors to clear up some doubtful points in the observations made on the Vega voyage, by combining with them the results of explorations by Saunikoff, Hedenström Anjou, and others. — W. H. D.

[420]

New charts of north-east Siberia.—The Hydrographic office of the navy department has issued a chart of Plover Bay, derived from Russian surveys by Maksitovich, and one of the Anadyr River estuary, founded on the surveys of the Telegraph expedition in 1865, with corrections by Russian officers on the ship Haidemak, in 1875. Following an error of the Russian hydrographic office, the title of 'Port Providence' is given to the whole of Plover Bay, and the latter name to the smaller and included port, in direct reversal of the custom of American and other navigators for the last thirty years. — W. H. D.

[421]

Graah's investigations of 1829-30 in Greenland.—Apropos of Nordenskiöld's Greenland expedition, a very full account of Graah's voyage, and a deserved tribute to his qualities as an explorer, appears in the last number of the *Deutsche geographische blätter*. This is doubly useful, as the account of the journey originally published has long been out of print, and difficult to obtain. The same number contains a statement and criticism of the hypothesis offered by Nordenskiöld in regard to the interior of Greenland, from the pen of Prof. Börgen, whose views have been sufficiently confirmed by the results of the voyage, so far as yet made public. — W. H. D.

[422]

(Africa.)

The Portuguese in Africa.—In support of the rights claimed by Portugal on the Kongo, and elsewhere in the interior of Africa, a memorandum was issued, some time since, by the geographical society of Lisbon, in which it was claimed for Portuguese explorers that they had revealed to science precise and exclusive information in regard to the orography and hydrology of the Dark Continent. The plea of this memorandum has been traversed by President Wauters, of the Royal Belgian geographical society, in a very lively and interesting article. Without expressing an opinion as to the merits of parties now struggling for supremacy on the Kongo, attention may be called to the manner in which the author shows how the characteristics of the hydrology of the interior of Africa on ancient charts were derived. Two centuries before the Christian era, Eratosthenes, from information obtained on the Ethiopian expedition of Ptolemy Philadelphus, described with tolerable accuracy the chief features of the river-system of Abyssinia, and placed the source of the principal branch of the Nile in a lake situated to the southward of that country. Ptolemy and the Arabian geographers added other lakes and branches, the details of which appear to have been based chiefly on rumor and imagination. In 1444 certain Abyssinian monks visited Rome on an ecclesiastical errand; and, from infor-

mation derived from them, Brother Mauro corrected the geography of that part of the Nile basin comprised in the Abyssinian watershed, the remainder finding its source on a vast marsh located in the centre of the continent. This appeared on his celebrated *Mappe-monde* in 1458.

According to the author and Father Brücker, the curious network of lakes and rivers found on the globes of Martin Behaim and medieval geographers, which suggest so curiously the lakes and rivers now known to exist, were all derived from the sources above mentioned. In many cases the names of the lakes and towns can be recognized; and in suppressing synonyms, and replacing Abyssinian rivers (which appear spread over central Africa on such maps) where they belong, the central region of the continent becomes almost a blank. It was reserved for the celebrated De Lisle, in the early part of the last century, to sweep from the charts every thing not due to actual observation, leaving to Livingstone and his successors the occupation of the blank thus made by delineating the physical features recognized in these modern and only authenticated explorations. — (*Bull. soc. Belg. géogr.*, ii. 1883.) W. H. D.

[423]

BOTANY.

Synonymy of higher cryptogams.—The 'Nomenclator der gefässkryptogamen,' by Carl Salomon, gives the genera and species of the higher cryptogams, together with their synonyms, and the geographical distribution of the species, — a work which is much needed by students in this department of botany. — W. G. F.

[424]

Ohio fungi.—The third part of the 'Mycological flora of the Miami valley,' by A. P. Morgan, has appeared, and includes the species of Agaricini from *Coprinus* to *Leuzites*. The paper is accompanied by colored plates of two new species, — *Coprinus squamosus* and *Hygrophorus Laurae*. — (*Journ. Cinc. soc. nat. hist.*) W. G. F.

[425]

Phycologia Mediterranea.—In this volume of about five hundred large octavo pages, Prof. F. Ardissoni of Milan describes the Florideae of the Italian coast, followed by the Bangiaceae and Dictyotaceae, under the heading *Incertae sedis*. From the context, however, one understands that the writer considers the two last-named orders to be nearly related to the Florideae. The descriptions and synonymy are given in full in Latin, and there are many notes in Italian on the microscopic structure and development. The antheridia of *Spyridia* are said to be unknown. They have, however, been described and figured in American specimens of *S. filamentosa*, which also occurs in Italy. — W. G. F.

[426]

Pollination of Asclepias.—Dr. Taylor speaks of the temporary capture of flies by *A. purpurascens*, and of the removal of pollinia by them on their escape, and suggests that North-American botanists examine the insects caught on our asclepiads for the peculiar pollen-masses (*Sc. gossip*, Sept.).

Like *Apocynum*, the milkweeds have long been known to catch insects not adapted to fertilize their flowers; and irritable movements have several times

been ascribed to their pollinia or stamens (e.g., Kirby and Spence, 'Entomology,' 7th ed., 167; Willdenow, 'Principles of botany,' 321; Potts, *Proc. Philad. acad.*, 1878, 293). In reality the insects are captured by a purely mechanical action of the fine V-cleft in the saddle of the pollen-mass, which seems especially adapted to hold the tarsal hairs of insects, especially certain Hymenoptera.

The pollinia have been frequently noticed on insects. Bee-keepers often complain that their bees become so weighted with them as to be unable to regain the hive. Potts (*Proc. Philad. acad.*, 1879, 207) mentions one bee which bore the remains of thirty pollinia; and Bennett (*Pop. sc. review*, 1873, 343) speaks of a butterfly which had eight entire masses, and the bases of eleven others, on one of its feet. Curious mistakes have also been made in descriptive entomology through a failure to recognize these bodies when they have been met with on insects. Savigny, in his great work on Egyptian insects ('Hymenoptera,' pl. 11), figures one as an appendage of the maxillary palpus of a Larrid; and his figure is copied by Westwood ('Modern classif.,' ii. 197), who says (p. 201) that 'it may possibly be the effect of disease.' Reakirt (*Proc. ent. soc. Philad.*, ii. 357) described them as natural appendages of the tarsi of a butterfly, giving them the name of eupronychia. If I am not mistaken, a species of *Mantispa* has also been characterized by the presence of these pollen-masses; but I am unable to refer to the description.

Among the numerous modern accounts of the pollination of the genus, none is more thorough than that given by Delpino, in his 'Fecondazione nelle piante antocarpee,' 1867. — W. H. D. [427]

ZOOLOGY.

Rare forms of microscopic life.—Dr. A. C. Stokes recently described and exhibited specimens of a new species of *Acinet*, a stalked, loricate infusorium. At the same time he called attention to an example of the blue *Stentor* (*Stentor ceruleus* Ehrenberg) which he thought had not been mentioned heretofore as found in America. He also announced that he had recently collected the beautiful rotifer, *Stepanoceros Eichhornii*, which, though abundant in Europe, appears not to have been previously found in this country. Specimens of *Salpingoeca urceolata* were also shown, which in no way differed from marine specimens. All the above forms of minute life were found in Watson's Creek, a small fresh-water stream in Mercer county, N. J. — (*Trenton nat. hist. soc.*; November meeting, 1883.) [428]

Mollusks.

Pulmonata of central Asia.—E. von Martens publishes a valuable contribution to our knowledge of central Asiatic Mollusca. The region treated of is between the frontiers of China and the Caspian, for which material has been gathered by Prjevalski, Potanin, and Regel. Besides descriptions of new forms, it contains a review of the fauna, with a tabular exhibit of the distribution of the different species. The central Asiatic *Helices* are broadly divisible into two groups: the one, characterized by

reddish and yellowish tints of coloration, and related to the *Fruticicola* of Europe, is more northern in its distribution; the other, allied to *Xerophila*, inhabits the Thian-Shan region, and is distinguished in general by sharper sculpture and a whitish color. Several forms common to the pleistocene and to the boreal region are found here, while several sections of the *Helices* not found in the pleistocene are also absent from central Asia. The fauna is more nearly related to that of the post-tertiary, or northern American, than to the existing fauna of middle Europe. The fresh-water snails are European, but *Unio* is conspicuous by its absence. A supplement by Schacko gives anatomical details of several species. — (*Mém. acad. St. Péterbourg*, (7), xxx. no. 11.) W. H. D. [429]

Mediterranean oysters.—The Marquis de Gregorio has undertaken a special study of the Mediterranean oysters, recent and fossil. Two short papers printed at Palermo give some preliminary results; among other things determining the existence in a living state, on branches of red coral, of the true *Ostrea cochlear* of Poli, believed to have become extinct. We recall, however, the identification of this species some time since, by Dr. Jeffreys and others, from specimens attached to a telegraph-cable which had been recovered from great depths for repairs. — W. H. D. [430]

Mollusks at the fisheries exhibition.—Dr. J. Gwyn Jeffreys prints some notes on the Mollusca exhibited. Leaving out oysters, which were well represented from Great Britain, the United States, and France, the collections are not remarkable. British Columbia showed a fine example, in spirit, of *Cryptochiton Stelleri*. This species, by the way, though rare in European collections, is abundant in proper localities from Santa Barbara, Cal., north and west to the extreme limit of the Aleutian Islands. It is eaten raw by the natives of Alaska. Norway showed a small collection of fine specimens of her mollusks, as did the museum of Gothenberg, Sweden. The most important and interesting collection was that of the *Vega*, dredged in the Arctic seas from Norway to Bering Strait by Baron Nordenskiöld. Among these was a *Pleurotoma* (from the description, closely resembling *P. circinata* Dall, of the Aleutian Islands), which Dr. Jeffreys believes to be larger than any other known species, and to which he has applied the name of *P. insignis*. — (*Ann. mag. nat. hist.*, Aug., 1883.) W. H. D. [431]

Worms.

Notes on worms.—C. Vignier has published a preliminary notice of his researches on the annelid *Exegone gemmifera* in the *Comptes rendus* (xcvi. 729), and promises a full memoir. — W. H. Caldwell gives, in the proceedings of the Royal society of London (xxxiv. 371), a preliminary note on the structure and development of *Phoronis*. — A third preliminary publication is that on the development of *Borlasia vivipara*, in the *Bulletin scientifique du département du Nord* (v. 462), by W. Salensky. — In the journal of the Linnaean society of London (xvii. 78), Dr. T. S. Cobbold describes *Ligula Mansoni*, n. sp. Twelve

specimens were found, in a Chinese, lying in the sub-peritoneal fascia about the iliac fossae, and behind the kidneys; a single one being found lying free in the right pleural cavity. They were twelve to fourteen inches long, and an eighth of an inch broad, and come near *Ligula simplicissima*. — H. Griesbach has given a preliminary report of his observations on the connective tissue of cestods, as studied in *Solenophorus*. His article appeared in the *Biol. centralbl.* (iii. 268). — J. Poirier found in the intestines of *Palonia frontalis*, from Java, three new Amphistomidae, for which he establishes two new genera, — *Homalogaster* and *Gastrothylax*. Three species are described and figured (*Bull. soc. philom. Paris*, (7), vii. 74). — J. Chatin reports a few observations on the histological alterations occasioned in man by trichinosis (*Ibid.*, 107). — The larvae of *Gordius* occur both in fishes and in many insect-larvae. In opposition to Villot, von Linstow maintains that the insects are the real hosts, and the parasites are present in fishes only accidentally, from their feeding on infested insects. — (*Zool. anz.*, vi. 373.) C. S. M. [432]

VERTEBRATES.

Direct irritability of the anterior columns of the spinal cord. — Mendelssohn, in the present paper, states that he has repeated all of the experiments of Fick upon the irritability of the anterior columns, and obtained similar results. In his own experiments, special efforts were made to prevent any escape of current on stimulating. The spinal cord was laid bare in its whole extent, and isolated from the surrounding parts by caoutchouc. The anterior and posterior columns of the cord were stimulated just below the brachial plexus, which had been previously divided; and the movements of the gastrocnemius muscle which resulted were registered upon a myograph. In some cases the anterior portion of the cord was completely separated from the posterior by a section running from the origin of the sciatic to the cervical cord. It was found in all cases that the reaction of the anterior columns was shorter than that of the posterior columns; that is, the time between stimulation of the cord and contraction of the gastrocnemius was less in the first case than in the second, the difference in time varying from 0.01 to 0.025 of a second. Assuming that the contraction resulting from stimulation of the posterior columns is reflex, then that resulting from stimulation of the anterior columns must be direct. — (*Arch. anat. physiol.*, 1883, 281.) W. H. H. [433]

Fishes.

Sudden increase of a rare sunfish. — Professor A. C. Apgar recently referred to the results of a fishing-excursion in central New Jersey. He found that the hitherto rare species of sunfish (*Mesogonistius chaetodon*) was remarkably abundant, and in a short time gathered seventy-five specimens. Where heretofore the common spotted sunfish (*Enneacanthus simulans*) and the still more abundant 'pumpkin-seeds' (*Lepomis gibbosus*) have been the characteristic species, these now appear to be largely crowded

out by the small banded sunfish, which but a short time ago was only to be found in scanty numbers and in very limited localities. — (*Trenton nat. hist. soc.*; November meeting, 1883.) [434]

Birds.

Anatomy of Biziura. — From the dissection of two males of *B. lobata*, Mr. Forbes finds that this duck forms an exception in that its trachea is simple, and devoid of a bulla, and that a subgular pouch, comparable to that of the bustards, exists. The ambiens tendon perforates the patella, as in *Phalacrocorax* and the *Hesperornis* of Marsh. — (*Proc. zool. soc. Lond.*, 1882, 455.) J. A. J. [435]

Does the Carolina wren mimic? — Dr. C. C. Abbott read a short paper on the habits of the Carolina, or mocking-wren (*Thryothorus ludovicianus*). He had carefully studied a pair of these birds for a year, seeing the male bird at least three times each week, from September to September. In all that time he had never heard the male bird utter a note not distinctively its own. Prof. Austin C. Apgar remarked that he had been familiar with the song of this wren for years, but had not heard it mimic; yet in all works on ornithology that refer to this species it is called the mocking-wren; and the habit is more or less referred to by Wilson, Audubon, and by Baird, Brewer, and Ridgway, in their 'History of North-American birds.' — (*Trenton nat. hist. soc.*; meeting Sept. 19.) [436]

The tongues of Tenuirostres. — In this paper, Gadow describes the modifications of the tongue which adapt it for sucking. The basal portion of the tube is formed by the rolling-up of the tongue, while the tip is formed by the rolling-up of the divided portion. In the *Melaphagidae* the end is broken up dichotomously into several tubes, and only the external borders of the tubes are lacinated. In the *Hectariniinae* the end is formed of only two tubes, and the internal edge is lacinated. In the hummers the tongue is double to near the base. Some peculiarities of the serpi- and mylo-hyoid muscles are mentioned. We notice that the author gives the anterior cornua of the hyoid apparatus as obsolete, though he describes the os entoglossum as double. From this we infer that he has forgotten that the ossa entoglossa are the anterior cornua. — (*Proc. zool. soc.*, 1883, 62.) J. A. J. [437]

Mammals.

Innervation of the movements of the iris. — In the reflex narrowing of the pupil, which takes place when the eye is exposed to light, it has been generally accepted that the afferent fibres concerned in the act follow the same general course as that taken by the rest of the fibres of the optic nerve, passing along the optic tracts to a centre somewhere in the neighborhood of the corpora quadrigemina. Bechterew has shown that this is not the case. Section of the optic tracts in various places, from the chiasma to the corpora geniculata, causes no dilatation of the pupil, and does not interfere with the reflex narrowing of the pupil when exposed to light. Injury of the corpora geniculata and of the corpora quadri-

gemina, so long as the lesion in the latter case does not extend so deep as to involve the origin of the oculo-motor nerves, gives the same result. Lesions of the gray matter of the lateral and posterior walls of the third ventricle, on the other hand, cause a widening of the pupil, and a loss of the 'direct' light reflex in the eye of the same side. If, however, the eye on the uninjured side is exposed to the light, a narrowing of the pupil of both eyes takes place, appearing to show that the lesion has involved only the afferent fibres, and not the reflex centre. The author's view of the path of the fibres is, that they leave the optic nerve at the chiasma, pass directly into the gray matter of the walls of the third ventricle, and end finally each in the nucleus of the oculo-motor nerve of its own side. The fibres do not cross anywhere in their course, since lesions of either side affect only the corresponding eye; and a sagittal section of the floor of the ventricle or of the chiasma is without effect. The nuclei of the oculo-motor nerves he considers as the true centres for the reflex; and the commissural fibres connecting these nuclei explain the occurrence of the indirect reflex, that is, the narrowing of one pupil when the pupil of the other eye is exposed to light. The dilatation of the pupils which follows painful stimulation of any portion of the periphery of the body cannot be owing to stimulation of fibres running in the sympathetic; since, in the first place, the widening is not maximal, as it is when the sympathetic is directly stimulated, and, in the second place, this reflex is entirely destroyed when a deep section is made behind, or in the posterior part of, the corpora quadrigemina. He explains the action of painful stimuli as an inhibition of the normal light reflex contraction of the pupil.

The pathological reflex paralysis of the iris, which occurs in certain diseases, in which the iris does not respond to stimulation of the eye by light or to painful stimuli of the body, is owing, he thinks, to an affection of the gray matter of the third ventricle. — (*Pflüger's archiv*, xxxi. 60.) W. H. H. [438]

ANTHROPOLOGY.

Languages and ethnology.—In a recent communication, Gustav Oppert proposes to divide languages, according to the mental propensity towards concreteness or abstractness possessed by the various races, and exhibited in their speech, into concrete and abstract languages. The concrete division is again separated into the heterologous (having special words when persons of different sex address each other), and homologous (males and females use the same words as if addressing their own sex). The abstract division is separated into digeneous and trigeneous. In the former all things are either masculine or feminine: in the latter there are three genders. Each division is again subdivided into three classes, as follows: 1°. Elder and younger relatives have special terms, sex denoted by the words 'male' and 'female,' or by modulation; 2°. Having special terms for elder brother and elder sister, but one in common for younger brother and younger sister; 3°. Having four distinct terms for each variety of kinship. Representing the concrete and abstract by C and A, their classes by α and β , and their groups by 1, 2, and 3, and the monosyllabic, incorporative, euphonic, euphonic inflectional, alliteral, agglutinative, agglutinative inflectional, dissyllabic inflectional, inflectional synthetical, and inflectional analytical, by I., II., III., IV., V., VI., VII., VIII., IX., and X., any

PHYSIOLOGIC.		HETEROLOGOUS α .			HOMOLOGOUS β .			DIGENEOUS α .	TRIGENEOUS β .
		1	2	3	1	2	3		
I.	Monosyl. . . .	- -	- -	- -	- -	- -	Chinese?	{ Old Egyp- tian.	- -
II.	Incorp. . . .	{ Many American, Basque.	Algonquin.	- -	{ Corean, Transgan- getic, Kfranti, Tibetan.	- -	- -	- -	- -
III.	Euphonic . . .	- -	- -	- -	{ Mandingo, Yoruba.	- -	- -	- -	- -
IV.	Euph. inflect. .	- -	- -	- -	- -	- -	- -	Hausa.	- -
V.	Alliteral . . .	- -	- -	- -	Kongo, etc.	- -	- -	- -	- -
VI.	Agglut. . . .	{ Polynesian, Australian.	Narrinyeri.	- -	- -	- -	- -	- -	- -
					Malayan.	{ Tungu- sian, Mongol- ian.	- -	- -	- -
VII.	Agglut. inflect. .	- -	- -	- -	- -	- -	{ Japanese, Fins, Turkish, Dravidian, etc.	- -	{ Hindustani, Bengali, Singhalese.
VIII.	Dissyl. inflect. .	- -	- -	- -	- -	- -	- -	Semitic.	- -
IX.	Inflect. synthet.	- -	- -	- -	- -	- -	- -	- -	{ Sanskrit, Zend, Greek, Latin, etc.
X.	Inflect. analyt. .	- -	- -	- -	- -	- -	- -	- -	{ Italian, German, English, etc.

language may be indicated, as in chemistry, by a symbol; as, C β 1 II. = Corean, Tibetan, etc. — (*Journ. anthrop. inst.*, xiii. 32-52.) O. T. M. [439]

Muskoki strategy.—The following method of Indian stratagem is told for the first time by Mr. H. S. Halbert. When a small party of Muskokis wished to attack a Choctaw village, they would arrange themselves in ambush at convenient intervals to within three hundred yards of the village. The bravest man would now crawl up as near the village as practicable, dig a pit and place himself in it, where he would wait until daybreak. The first

Choctaw whom he then saw stirring about near his ambuscade he would shoot down, spring forward, and scalp him in the twinkling of an eye. He would then flee toward the second ambuscader. If he was pursued, which was generally the case, the pursuer received the fire of this ambuscader. The two warriors then fled to the third man in ambush. If the pursuers still followed, they received the fire of this man. The three now ran to the fourth ambushed warrior, where the same scene was enacted; and so on until the place of the last man was reached. — (*Amer. antiq.*, v. 277.) J. W. P. [440]

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

Geological survey.

Paleontology.—Mr. Lester F. Ward, paleobotanist of the survey, is at work preparing a catalogue of fossil plants, with their geological relations, which will probably be published during the coming spring. Fifty-one boxes of Fort Union fossil plants, collected by Mr. Ward near Glendive, Montana, last July, have been received at the office of the survey.

A paleontological report on the paleozoic fossils of the Eureka district of Nevada, by Mr. Charles D. Walcott, is almost ready for the press. The number of paleozoic fossils from this district exceeds four hundred species.

During the month of October a large number of Potsdam fossils from Saratoga, N.Y., and some Trenton fossils from Trenton Falls, N.Y., were added to the collections in the hands of Mr. Walcott, who has charge of the department of paleozoic paleontology.

One of the papers in the fourth annual report of the survey is 'A review of the North-American fossil Ostreidae,' by Dr. C. A. White. It will be illustrated by forty-eight full-page plates of figures, giving figures of all the leading species of fossil forms of oysters, and of the leading varieties of *Ostrea virginica*, for comparison. For it, also, Professor Angelo Heilprin furnishes a revised catalogue of the tertiary oysters; and Mr. John A. Ryder adds a concise life-history of the common oyster, illustrating its anatomy, and giving the results of his recent experiments in the artificial propagation of oysters.

Chemistry.—A laboratory, to be in charge of Prof. F. W. Clarke, is being organized in connection with the survey. Heretofore the chemical work of the survey has been done at various laboratories scattered through the country, and at the field-laboratories at Denver, Salt Lake City, and San Francisco. A laboratory for physical experiments will probably be established in connection with the chemical division.

West-Virginia forests.—During September and October, Col. George W. Shutt examined the southern and eastern portions of West Virginia with especial reference to the distribution of timber, its economic value, and the facilities of transportation to market

via the streams of the region. He travelled over a thousand miles by wagon, and two hundred on horseback, and expresses the opinion that nearly one-half of the state is covered with a virgin forest, the value of which, if rendered marketable, would amount to billions of dollars.

Geology.—In making an excavation a few weeks ago for a building on Connecticut Avenue, in the north-western section of Washington, D.C., the interesting discovery was made of the remains of a subterranean forest. The fact was mentioned at the meeting of the Biological society of Washington, Nov. 2, by Professor Lester F. Ward; and, from the excellent preservation of the wood, the opinion was expressed that it was simply a collection of drift-wood that had been washed into a ravine in comparatively recent time. Mr. W. J. McGee of the Geological survey, who has been working up the geological structure of the District of Columbia for some time, had also examined the locality in question, and was of the opinion that the deposit was of quaternary or prequaternary age. A few days after the meeting of the Biological society, above mentioned, he, with Professor Ward, Mr. G. K. Gilbert, and Mr. J. B. Marcou, re-examined the buried forest; and Mr. McGee's opinion was confirmed,—the stratum was found to underlie the quaternary gravels of the district. The occurrence is of interest, since the slightly altered wood undoubtedly represents the end of the long interval extending from the cretaceous to the beginning of the quaternary, during which the lignite beds and iron-ore deposits, so common in the region, were formed.

Publications.—The survey has just issued a miscellaneous work, one of a series of statistical papers, which is distinct from the Monographs and Bulletins, but, like them, is for sale at cost price (fifty cents in this case). The title of this work is, 'Mineral resources of the United States,' by Albert Williams, jun., chief of division of mining statistics and technology. In its 813 pages it gives the statistics of our mineral production for the year ending June, 1883, and also a mass of information in relation to the production of coal, petroleum, iron, copper, lead, and zinc. It also treats of building-stones, clays, fertili-

zers, etc., and gives lists of the useful minerals of the United States, with localities, and concludes with extracts from the new tariff relating to import duties upon chemical products, metals, mineral products, etc. It will therefore be seen that the work is of practical value; and this fact is also indicated by the demand for it, which comes largely from miners and mine-owners, particularly from the west.

Bulletin no. 2 of the survey is also by Albert Williams, jun. Its title is, 'Gold and silver conversion-tables, giving the coining values of Troy ounces of fine metal, and the weights of fine metal represented by given sums of United States money.' It is a pamphlet of eight pages, and is of especial value to assayers and bullion-dealers.

The third annual report is printed, and waiting for a few of the illustrations. The fourth annual report, with the exception of the index, is in type. Both these reports will probably be issued early during the forthcoming year.

Dutton's 'Tertiary history of the Grand Cañon district, with atlas' (volume ii. of the Monographs of the survey) has been distributed to European institutions, and will now be distributed to American institutions.

Volume iii. of the Monographs, 'Geology of the Comstock lode and Washoe district,' with atlas, by George F. Becker, is being delivered to the survey by the government printer, and will soon be ready for distribution.

The Monographs of the survey are not for gratuitous distribution. They can only be distributed through a fair exchange for books needed in the library of the survey. Copies over and above the number needed for such exchange are for sale. The price of volume ii. is \$10.12, and of volume iii., \$11.

NOTES AND NEWS.

THOSE who are interested in our leading article this week will be pleased to learn, that, in his will, Barrande bequeathed his collections, library, and undistributed copies of his publications, to the museum at Prague. He further provided for the continuation of his work by a bequest of ten thousand florins to the museum, which, by its acceptance, pledges itself to fulfil his wishes. Drs. Krejčí, Frič, Kořiska, Prachenský, and Bellot were appointed by him a commission to see that his designs are carried out; and Drs. Waagen and Novák, well-known paleontologists, designated to execute the work,—the former to complete the 'colonies,' gasteropods, and echinoderms; the latter, the bryozoans and corals.

The museum proposes to establish a Barrande fund for supporting further studies on the Silurian formation of Bohemia; and any gifts that may come from America for that purpose would, we are assured, be deemed particularly valuable. The editor of SCIENCE will be pleased to forward to the museum at Prague any contributions that American naturalists may desire to make, and to acknowledge the same in these columns.

—Sir Charles William Siemens died in London, Nov. 20. He was born at Leuthe, in Hanover, in 1823. From 1844 he resided in England. In 1858 he established, with his brother, the firm which has become famous through the telegraph-cables they have made. For ten years (1853-63) Dr. Siemens was engaged on the regenerative gas-furnace, and since that time his methods of manufacturing steel have met with the greatest success.

—Information has been received from Sunda Straits, giving details of the hydrographical and topographical changes due to the great Java earthquake. These seem to be less extensive than heretofore reported by the press. Commander P. F. Harrington, U.S.N., reports the hills and trees in the vicinity of St. Nicholas Point covered with ashes, but otherwise unchanged. The soundings here remain the same. The sea has rushed through the valleys of Thwartway Island, tearing away the vegetation, and leaving the low land bare; and, from a distance, these breaks in the forest give it the appearance of five islands, but there is no change in the shore-line or soundings. The same is true of Anjer, where the base of the lighthouse at Fourth Point, and the buoys of the submarine cable, are the only monuments of that populous town. The plains have been swept by the sea, and show only uprooted palms, and ghastly relics of the inhabitants. Krakatoa volcano appeared active; but on a nearer approach it was found that the appearance resulted from ashes, etc., falling down the precipitous cliffs, and carried off by the wind.

The north-western part of Krakatoa Island has disappeared. The immense mass which is missing seems to have formerly been the choked-up crater; and its material has probably modified the sea-bottom northward from its place. No bottom could be found in the vacant spot with twenty fathoms of line. Prior to the eruption, Verlaten and Lang islands were covered with verdure. Their contour has been but slightly changed, but they are covered with scoria. A small island has formed eastward from Verlaten. The Polish Hat has disappeared, and where it stood is more than twenty fathoms water. A new rock, about twenty feet in height, has risen in eight fathoms, near the southern point of Lang Island. The channel south from Bezee Island has been closed to navigation by reefs and islets not yet surveyed. From the northern end of the island a reef extends in a north-westerly direction, apparently connecting with other islands to the westward.

The whole coast of Java between Second and Fourth points has been swept clean by the sea, but there is no essential change in the shore-line and soundings. Masses of floating pumice are wedged in Lampong Bay, and interrupt communication with Telok Betong. The lighthouse at Java Head remains undisturbed, as does that at Flat Point. Other dangers may be developed on a careful survey, but the main gate of the Straits of Sunda seems unimpeded.

—Mr. W. F. Denning of Bristol, Eng., noting the fact that accounts of large meteors form a frequent subject of correspondence in the columns of scientific journals, but that it is not often the case that the

descriptions of these phenomena are sufficiently exact to be valuable for purposes of calculation, suggests, in a letter to the editor of *Nature*, the proper methods of useful observation of these bodies. Rough estimates of the direction and position of flight are of little utility; and the vague statements often made occasion an endless source of difficulty in the satisfactory reduction of results. The observers of large meteors should attend scrupulously to that most essential detail, the direction of flight, and express it by some method of uniformity. In place of the customary vague and variable methods of description of the apparent paths of these bodies, Mr. Denning suggests that observers uniformly give the right ascension and declination of the beginning and end points of the visible paths, — elements which admit of ready determination by projecting the observed flights upon a star-chart or celestial globe, and reading them off. This system would render the after-comparison of observations a work of greater facility and precision. Though the direction of flight is the all-important element to be determined by meteor-observers, some minor points — as the time of appearance, brightness, and approximate duration — should be recorded whenever feasible; also whether the body is accompanied by phosphoric streaks or spark-trains. If this were done more systematically, the observations of fire-balls would acquire additional value, and quite possibly might develop some new facts either as to their appearance or origin.

— Mr. Thomas Gaffield read a paper on glass and glass-making, illustrated by specimens, at a meeting of the Society of arts of the Massachusetts institute of technology, Nov. 22.

— At the meeting of the Portland, Me., society of natural history, Nov. 19, the president, Dr. Wood, gave account of the unearthing of bones of some unknown animal from a peat-bed on Ragged Island, Casco Bay, by Capt. Thomas Skolfield in 1835. Eighty-five feet in length of vertebral bones were taken out and thrown away. The head and tail were not uncovered, and the animal was estimated to be a hundred and ten feet long. No ribs were found, and no marks of rib attachment appeared on any of the vertebrae, which were hard and smooth. Only four bones were saved: two were given to the Portland society, but were burned in 1854; the other two have been lost sight of, but were said to have been taken to the Philadelphia academy in 1836 or 1837, by a Mr. Coolidge. Of the two given to the society, the large one was unquestionably a vertebra: its length was from fourteen to sixteen inches; its diameter, nine or ten inches on the articular faces, and eight midway. The other bone was limpet-shaped, four or five inches in diameter and height. The shape and size of these bones are well remembered by members of the society, and Capt. Skolfield; and the story of the last is well vouched by many others.

Two unsuccessful attempts have been made by the society to unearth more bones. Another trial will be made next season.

— On the retirement of Mr. R. Hering from the presidency of the Engineers' club of Philadelphia, at

the close of its fifth year, he gave a summary of recent progress (*Proc. eng. club Philad.*, iii.). The work of the late U. S. board appointed to test iron, steel, and other metals, was referred to; and it was stated that there was at least some possibility that its work may be in time resumed. The chief of ordnance recommends that an appropriation of ten thousand dollars be made by Congress for the purpose, as urged by the convention of the societies of civil, mechanical, and mining engineers. The differentiation of the profession into the several branches, — civil, mechanical, mining, — and the subdivision of these into specialties, were considered as marking the tendency of recent change. Inventions are coming forward with increasing number and rapidity, but it is becoming each day more evident that they are all the products of growth and of gradual development. No new thing comes into use at once fully perfected. Of accomplished work, the East-river bridge, with its span of 1,595 feet, suspended 135 feet above the water; our Kinzua viaduct at Bradford, 2,052 feet long, spanning a valley 302 feet below it; the Henderson bridge over the Ohio, of 525 feet span; and the great bridge to be built over the Firth of Forth, — are among the most marvellous. The great canals in progress, or proposed, — that in Florida, opening the Kickapoochee Lake; the interoceanic canal through the Isthmus of Panama; the great Sirhind canal in India, 500 miles long; the Corinth canal in Greece; and the Manchester ship-canal, — are evidences that the days of canals are but just commencing. The United States boast to-day 116,000 miles of railroad, and are building over 30 miles per day, and earning \$550 per mile. Locomotives for the Pennsylvania railroad are built weighing over 60 tons, and make 90 miles in 80 minutes. Electricity is a competitor, which, however, is not likely at once to displace steam on the rail. Heat and steam supplied from a central station, as at New York, where the New-York steam company are preparing to work 16,000-horse power of Babcock & Wilcox boilers, 2,000-horse power of which are constantly at work, is a promising illustration of advance. Electricity similarly distributed, — as by the Edison company and the Brush company, — and the telephone, are the latest of these achievements of the profession. Sanitary engineering, although the most essential of all, seems to be the last to come in, and is but now beginning to take its place.

— Since the article in this number on crystals in the bark of forest-trees was in page, the writer has seen a recent work, *Anatomie der Baumrinden*, Berlin, 1882, Dr. Joseph Moeller, in which the subject is fully treated and richly illustrated.

— Microscopists will regret to learn of the death of Mr. Robert B. Tolles at Boston, on the 17th, at the age of sixty-one. No one has done more than he to raise the standard of excellence of American objectives for the microscope; and his ingenuity in devising special methods to overcome particular difficulties is known to all who have tested his powers. He has been in feeble health for several years, but continued to work with astonishing vigor and pertinacity.